APoDDS: A DDS-Based Approach to Promote Multi-Agent Systems in Distributed Environments

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Abstract. Multi-agent systems (MAS) paradigm emerged as an innovative technology that seemed to be applicable to a large number of distributed problems. However, during these years, ubiquitous computing and ambient intelligence among other distributed paradigms have proposed problems that are currently coped with other technologies. MAS have remained in research environments without establishing themselves in the distributed computing field, despite the benefits it could provide to it. In this paper, the key factors that have produced this situation are pointed, and solutions in order to fix it are proposed. APoDDS is a platform which collects all these solutions and merge them. Finally, a comparison between the new approach and the well-known agent platform JADE is made in order to evaluate the proposal.

Keywords: Multi-Agent systems, Distributed Computing, Communication Middleware.

1 Introduction

During the last two decades, several distributed computing models have emerged. Ubiquitous and pervasive computing, context-aware computing, ambient intelligence and cyber-physical systems are some of these models. The trend is to get more and more distributed systems around us. Avionics, automotive systems, health-care, monitoring, control systems and entertainment are just a few examples of current and future distributed applications.

In the 90’s and because of their properties, Multi-Agent paradigm seemed to fit perfectly with all these distributed environments. MAS are composed by agents, which are defined [9] as independent computational entities allocated in any environment, which are able to act autonomously within that scenario in order to reach its objectives. They have mainly the following two properties [8]. Firstly, they are
autonomous. They can decide the next action to do to accomplish its goal. Secondly, the communication capability. They must be able to communicate with other agents or entities for solving the problem. In distributed computing models both autonomy of the elements which form the distributed environment and communication are key features. The relation is direct, MAS seems to fit in distributed applications, and this symbiosis is an advantage since it allows developers to think clearly about the final goal and use the concept of agent in order to accomplish it.

However, despite the many benefits that MAS can give to distributed computing models, they remain constrained to research environments. Currently, distributed problems are solved by means of other technologies, like Service-Oriented Architectures. MAS can be deployed alongside other technologies in order to improve the solution to the distributed environment, bringing several advantages to distributed environments. Therefore, in this paper, the main factors that have disabled MAS from being used in distributed environments are pointed. Then, solutions in order to tackle these problems are proposed. APoDDS takes all these solutions and establishes them as design requirements, then a new platform is implemented and it is compared to the well-known agent platform JADE [1]. The remainder of this paper is organized as follows. The main problems of MAS are collected through studying the state of the art in Sect. 2. In Section 3, the design of APoDDS is described, and its advantages are shown. A comparison between APoDDS and JADE is done in Sect. 4. Finally, conclusions and future work are presented in Sect. 5.

2 State of the Art Analysis

This section is organized as follows. Firstly, the state of the art regarding Multi-Agent systems applied to distributed environments is investigated, and the problems that have the different approaches are shown. Then, these problems are defined and specific solutions are proposed.

2.1 Problems of Multi-Agent Platforms

In order to make an accurate investigation, the state of the art is focused from two different perspectives.

**Versatility and scalability.** There are a large number of different distributed applications, with their own requirements and needs. Some properties are common, like autonomy and communication, but other ones are domain-specific. Hence, it is necessary for the technology that is going to tackle the problem to be versatile enough. Multi-Agent paradigm is very versatile, but this is not the general case of current agent platforms which implement the paradigm. The FIPA standard [10] was designed in order to homogenize Multi-Agent systems. It offers a defined architecture and several facilities. While this can suppose various advantages, a FIPA-compliant Multi-Agent platform is constrained to this standard. In FIPA architecture, it is defined an entity called Directory Facilitator, which is a directory agent in charge of