

A Middle Agent Based Super Architecture for Scalable and Efficient Service Discovery

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Abstract – *It is typical that in a multi-agent system there exist service requestor agents that search for suitable service provider agents to solve specific problems. In this environment, service discovery can be achieved with the use of a middle agent(MA) who provides matchmaking services. Multiple federated MAs can be employed and dynamically discovered to avoid bottleneck problem and single point of failure. In addition, a peer-to-peer(P2P) network can be utilized for a wider scope of discovery. In this paper, we propose a middle agent based super peer architecture (MESRA) for wide area service discovery. We explore scalable and efficient discovery through exploration which results in the formation of similar service overlay networks and monitoring which caches service requests results. Simulation experiments show that MESRA provides better performance as compared to discovery through purely super peer (PSP) and Gnutella based overlay networks.*

Keywords: MultiAgent Systems, P2P, Agent Service Discovery.

1 Introduction

Like a human in a human society, a software agent in a multi-agent system (MAS) engages social activities with other agents during its lifetime [27]. Agents must communicate and collaborate with each other to solve complex problems, unachievable by a single agent. Such an environment requires the ability of an agent to discover other agents that can provide the services that it needs. This can be described as the service discovery problem [7]. The agents that are in need of services are called service requestors while the agents that can provide services are called service providers. An agent can become both a provider and a requestor at the same time. This discovery problem becomes more complicated if a dynamic and open Internet-wide MAS is to be supported which necessitates the system to address issues such as scalability and reliability [4]. Systems that require prior knowledge of service providers and that rely on centralized control are certainly not suitable.

An often used approach that addresses the service discovery problem is the employment of middle agents or matchmakers [6][7] whose tasks are to allow provider agents to advertise their services and also to provide lookup services (eg. yellow

page directory service) for requestor agents. A middle agent (MA) has to maintain a service registry where registered services are stored and where search is being referred to when resolving a request. The use of a centralized MA is not suitable for the wide-area and large scale environment since it is not scalable (eg. causes bottleneck problem as the number of agents increases) and can suffer single point of failure. As a solution, multiple MAs can be employed where each MA handles only certain part of the whole resources. These MAs can exist either without any cooperation among them such as Lookup servers in JINI [2] and Directory Agents in SLP[13] or they are allowed to federate among one another such as Brokers in InfoSleuth [3][19] and Matchmakers in Retsina [23]. Federation allows MAs to cooperate such as in the processing of service requests. For example, when a MA cannot find the requested service in its local repository or if the number of search results is to be maximized, it can forward the request to others in the federation. However, in a dynamic and open environment like the Internet, the federation cannot be statically configured since any MA can autonomously join or leave the federation. Furthermore, it is unlikely for a MA to know all other MAs in the network. Even so, it is also inefficient for the MA to forward or broadcast a search request to all others in the federation.

Peer-to-peer (P2P) networks such Gnutella[11], Morpheus [17] and KaZaA [14] have become popular infrastructures especially in the domain of file-sharing. Considering the advantages of the P2P systems such as large scale, highly dynamic, decentralized and selforganized, we would like to investigate on how we can integrate the P2P protocols for the discovery of agents in the dynamic MAS environment. We propose a MA based super peer architecture (MESRA) which is based on the super peer network [28] where each MA resides in a super peer node and is interconnected to other MAs through the super peer P2P topology. Other types of agents reside in normal peer nodes and become clients to their local MAs hosted in the super peer nodes. We also enhanced the super peer model to improve scalability and efficiency of the discovery process. In this case, each super peer is capable to explore the network to find other super peers with similar type of service providers which result in the formation of overlay networks of related super peers. The capability to