

# Agent-Based Network Infrastructure for E-Communities

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## INTRODUCTION

Virtual communities represent the gathering of people, in an online “space” where they come, communicate, connect, and get to know each other better over time. Virtual communities can be created for different purposes moving from the simple socialization among people to the collaboration among remote people working on shared projects.

Virtual communities are usually managed through dedicated software systems, also called social software systems, providing the basilar members management services and a set of services specialized for the kind of members they connect. The realization of efficient and reliable systems for the management of virtual communities is not easy because they need to manage the interaction among remote users, possibly connected through heterogeneous networks and often requiring services that cannot be managed through the classical Web-based solutions because sometimes these services require to access software/hardware resources available at the user site.

Agent technology has been proven as one of the most interesting technologies to simplify the interaction among remote users and applications. In fact, it is well-suited for applications that are communication-centric, based on distributed computational and information systems, and requiring autonomous components readily adaptable to changes. Moreover, the use of agent technology for realizing complex systems provides conceptual simplicity, enhances scalability, and makes interactions in a large collection of information sources and users become tractable.

As introduced in Hattori et al. (1999), there are several characteristics of network communities that make the use of multi-agent systems attractive to realize support systems for managing the interactions among the members of the communities. First, the participants of a network community are widely distributed, and the number of potential participants can be large. Another characteristic is that communities have a dynamic nature because the active members will change over time, in addition to roles of individuals and objectives, and moreover, the community will likely change its aspect. In other words, there does not exist a fixed organization nor a clear goal for a network community. This characteristic contrasts the area of groupware, which helps people already organized to work cooperatively where the members, their roles, and their objectives are rather clearly defined. In addition, the individuality of each member is preserved. That is, each member can have diverse objectives, even if all members share common interests in general. Furthermore, people can be members of several communities at the same time, depending on their various interests. Hence, support needs to be personalized to adapt individual objectives and interests. They also need to adapt to the variations and changes of interests and activities of individuals.

In particular, *RAVE* is a system for realizing agent-based applications that provide information and expert searching facilities for communities of users working or interested in common or similar topics. The main feature of such a system is the use of multi-agent technologies for realizing a network infrastructure for virtual communities support that can be easily customized to provide services specialized for specific kinds of interests/topics.

## BACKGROUND

Several prior systems support expertise recommendations in virtual communities and organizations. Expert Finder is a system that recommends individuals who are likely to have expertise in Java programming (Vivacqua & Lieberman, 2000). This system analyzes Java code and creates user profiles based on a model of significant features in the Java programming language and class libraries written by the user. User profiles are then used to assist novice users in finding experts by matching her/his queries with user profiles. Expertise Recommender (ER) is another system that recommends people who are likely to have expertise in a specific area (McDonald, 2003). A user garners recommendation from ER by picking a relevant identification heuristic, selecting a matching technique, and entering a description or terms related to a problem. Then, the system responds with a list of individuals who are likely to have expertise with the problem and who are a good social match for the person making the request. In this system, user profiles are built by processing user's day-to-day work products. MARS is a referral system based on the idea of social network (Yu & Singh, 2003). This system is fully distributed and includes agents who preserve the privacy and autonomy of their users. These agents build a social network learning models of each other in terms of expertise (ability to produce correct domain answers), and sociability (ability to produce accurate referrals), and take advantage of the information derived from such a social network for helping their users to find other users on the basis of their interests.

Several prior systems use multi-agent systems to provide services for virtual communities and organizations. CASBA is a system providing electronic commerce services in virtual communities (Kraft et al., 2000). In particular, this work integrates a multi-agent market framework into a virtual community support system, called VR-SHOP that provides 3-D graphical representations of the participants to provide a more natural interaction among them. TeleCare is a configurable framework for virtual communities focused on supporting assistance to elderly people (Camarinha-Matos & Afsarmanesh, 2005). TeleCare provides, besides classical services for virtual community management, a set of services specialized for the elderly, that is, specialized user interfaces usable by people that are not familiar with computers, living status monitoring, agenda reminder and entertainment.

The main feature of such a system is the integration of multi-agent and federated information management approaches to provide a flexible infrastructure on top of which realize a set of specialized care services.

## RAVE

Remote assistance virtual environment (RAVE) is a system for realizing agent-based applications that provide information and expert searching facilities for communities of users working or interested in common or similar topics.

A RAVE-based system associates a personal assistants with each user which helps her/him to solve problems and find relevant information: the assistance is provided proposing information extracted from some information repositories and getting its user in touch with "experts" on the topic, selected on the basis of their profile. A personal assistant also maintains a user profile centered on her/his competences and experience. The profile is built through the positive answers given to other users and by extracting information from the documents that the user produced or collected.

A RAVE system is given a dynamic network of peers, each of them represented by an agent platform, distributed on one or more computing nodes and containing, besides the agent assistants, some agents for managing the access to the information maintained in such computing nodes.

The main feature of this system is that it can be easily customized to manage different services to support the exchange of information among the members of a community. These services can be oriented to support the direct interaction among the members and/or to support the access to the information produced or collected by the different users of a community. Moreover, some services can be useful for any kind of information; other services are specific to a specific type of information (e.g., java programming, photo collections, etc.). In particular, while the interaction between agents and between an agent and its user is independent from the type of services offered to the community, domain ontologies and terms used to realize user and document profile are, of course, different. This last fact does not affect the algorithms used for retrieving the information (that are the same for all the services), but, for example, suggests the realization of specialized user interfaces for helping in the interaction about a specific interest/topic.

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