Klaus Fischer
Ingo J. Timm
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Multiagent System Technologies

4th German Conference, MATES 2006
Erfurt, Germany, September 2006
Proceedings

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Am Fallturm 1, 28359 Bremen, Germany
E-mail: i.timm@tzi.de

Elisabeth André
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Institut für Informatik
Eichleitnerstr. 30, 86135 Augsburg, Germany
E-mail: andre@informatik.uni-augsburg.de

Ning Zhong
Knowledge Information Systems Lab.
Maebashi Institute of Technology
460-1 Kamisadori-Cho, Maebashi-City 371-0816, Japan
E-mail: zhong@maebashi-it.ac.jp

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Preface

After three successful MATES conferences in Erfurt in 2003 and 2004 and in Koblenz in 2005, the 4th German conference on Multiagent System Technologies (MATES 2006) took place again in Erfurt collocated with Net.ObjectDays 2006. Building on other agent-related events in Germany in the past, and organized by the GI German Special Interest Group on Distributed Artificial Intelligence, the MATES conference series aims at promoting the theory and applications of agents and multiagent systems.

As in the past years, MATES 2006 provided a distinguished, lively and interdisciplinary forum for researchers, users, and developers of agent technologies, to present and discuss the latest advances of research and development in the area of autonomous agents and multiagent systems. Accordingly, the topics of MATES 2006 covered the whole range from theory to applications of agent and multiagent technologies. The technical program included a total of 23 scientific talks, and demonstrations of selected running agent systems.

The international Program Committee for MATES 2006 selected carefully 15 out of 52 submissions from all over the world to be accepted as full papers. Additionally, eight papers were selected for short presentations which are, however, published in *International Transactions on Systems Science and Applications*. The program included four distinguished invited speakers: Frank Dignum, Joaquim Filipe, Omer Rana and Hong Zhu.

Finally, as General Co-chairs and PC Co-chairs, and in the name of all members of the Steering Committee, we would like to thank all authors of submitted papers and all invited speakers for their contributions, all members of the Program Committee as well as other reviewers for their careful, critical, and thoughtful reviews, and all local conference organizers and others involved in helping to make MATES 2006 a success.

We hope the attendees enjoyed MATES 2006 and the conference site in Erfurt both scientifically and socially and will continue to support MATES as a conference series with many more successful events to come in the future!

July 2006

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Adding New Communication Services to the FIPA Message Transport System

Javier Palanca, Miguel Escrivá, Gustavo Aranda,
Ana García-Fornes, Vicente Julian, and Vicent Botti

Dept. Sistemas Informáticos y Computación
Universidad Politécnica de Valencia
{jpalanca, mescriva, garanda, agarcia, vinglada, vbotti}@dsic.upv.es

Abstract. Agent communication is one of the most important aspects in the multi-agent system area. In recent years, several works have been developed that are related to the agent communication problem.

This paper presents a new method for agent and agent platform communication in accordance with FIPA proposals. It uses the Jabber protocol as a new message transport protocol (MTP). This protocol provides additional services that are not included in the current standard FIPA MTP. It provides facilities for "presence notification", "multi-user conference" and "security services". As a result of this work, a new plug-in for the JADE platform that incorporates this transport protocol has been developed.

1 Introduction

Some multi-agent platforms allow external communication by means of using their own protocol and schema of communications. Good performance can be achieved this way, but it is not possible to inter-operate with a different platform that does not understand this particular way of communication. There are platforms that are capable of communicating using standard protocols agreed upon by consortiums like the FIPA [1]. The most widely used standard protocol proposed by the FIPA is the Hypertext Transfer Protocol (HTTP) which is a protocol that was originally conceived to transfer web pages from a server to a web browser. Although this protocol is rather simple and allows some kind of bidirectional communication between client and server, it is not designed to sustain lengthy conversations over time as it is focused towards a 'query and result' routine. These are detected drawbacks in current Message Transport Protocols for agent platforms.

This paper proposes a new method of communicating agents and platforms using a more *human-oriented* way to develop conversations: Jabber [2,3], an Instant Messaging (IM) protocol designed to sustain lengthy bidirectional communications among entities on the Internet. This new Message Transport Protocol has been proposed to the FIPA consortium as a new preliminary specification. Besides, this paper introduces new services into agent communication that are only

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possible by integrating the Jabber technology in the FIPA Message Transport System.

A software add-on to the JADE agent platform that uses the new communication structure presented in this work has been developed and accepted by the JADE development team [4].

Next sections are structured as follows: Section 2 introduces a brief description about Instant Messaging and, in particular, the Jabber protocol; Section 3 introduces our proposal of using Instant Messaging to communicate agents. This section describes how an Instant Messaging protocol can be used to improve agent communication taking advantage of its features (like presence notification or multi-user conference); Section 4 describes our contributions to the Jabber protocol in order to support FIPA agent communication. This contribution have been submitted to the FIPA Consortium; Finally, conclusions are presented in Section 5.

2 Jabber Protocol

Jabber is an open protocol that is based on standard XML (eXtensible Markup Language) for the exchange of messages and presence information between two Internet points. This protocol was proposed by the Jabber Software Foundation [5].

The main use of Jabber technology is an extensible IM network that has similar features to other IM services like AIM, ICQ, MSN Messenger and Yahoo. Therefore, Jabber is an open, secure, and free alternative to consumer IM services. Under the hood, Jabber is a set of streaming XML protocols and technologies that enable any two entities on the Internet to exchange messages, presence, and other structured information in close to real-time.

Jabber is a communication protocol and can be applied to many scenarios. Its base is an XML-based messaging technology that can be used to communicate different entities. Its most common use is a decentralized instant messaging network, but this is not its sole application, as seen in the present work.

The term Jabber makes reference to a number of elements that, together, conform an infrastructure for the interchange of messages in real-time. The *technical* name of Jabber is XMPP, for eXtensible Messaging and Presence Protocol. It is a standard technology formalized by the Internet Engineering Task Force (IETF) based on the core protocols created by the open-source community [2]. The Jabber and XMPP terms can be used interchangeably.

XMPP technology has many advantages over existing proprietary closed ones. Being an open and free standard, which is also based in other open standards (XML, SSL, ...), it is not subject to sudden changes in its definition that may, for instance, render it to be incompatible with previous versions of the technology (as is the case with the MSN Messenger technology). It comes from a well-documented, open specification, which has eased the appearance and availability of many different types of clients, servers and *bridges* that enable the possibility of interacting with other communication networks, such as email, SMS messages for mobile phones or other IM systems.

The Jabber network has a distributed architecture, which means that there is no central server that handles all the message delivery. Jabber servers cooperate together to bring messages from one user to another, like email servers do.

In the following list, we present the advantages of Jabber for the communication, specially over other similar proprietary networks: *Open, public, free, asynchronous, standard, tested, decentralized, secure, extensible and flexible.*

Bearing this in mind, it is clear that Jabber can be deployed to provide solutions far beyond the IM space as well as within it. Jabber applications beyond IM include network management, content syndication, collaboration tools, file sharing, gaming, remote systems monitoring and, now, agent communication.

3 Instant Messaging for Agents

In this section our contribution to a new agent communication framework is presented. This work presents the adaptation of the Instant Messaging technology to improve communication in multi-agent systems. We have studied instant messaging features that were interesting for agent communication and adapted them into a proposal for the FIPA standards.

3.1 Main Features

From a certain point of view, agents can be viewed as *'living'* intelligent entities, and so, all the advantages that benefit human users can also benefit agents. *'If IM is good for humans... Is it good for agents?'*.

Instant Messaging (IM) was initially developed to communicate humans. This technology has the ability of sending messages between two entities in a network. These messages are delivered in real-time (that's why it is called *'instant'* messaging) and are usually of text nature, although they can be any other kind of data (like binary or meta-information) if the protocol allows it.

Instant Messaging Networks also have more properties such as Presence Notification or Multi-User Conference. Presence Notification allows a user in the IM network to be notified when another user (who is a member of his/her contact list) changes his/her state.

Multi-User Conference is a technology that provides *chat rooms* where users can virtually *come together* and easily talk to more than one user. This feature is similar to the common Internet Relay Chats (IRC).

IM networks provide communication between human users in an unstructured way, using natural language. By changing the natural language used by humans for a common conversation with a standard structured language, like FIPA-ACL, and by inserting the necessary meta-information in a message (as shown in Section 4.1) it could be possible to re-use a common used Instant Messaging platform for agent communication. This is a more natural way to perform conversations between entities that involve interaction protocols.

Using an IM technology like Jabber for communicating agents seems like a natural step, since its innermost structure is quite analogous to what is commonly referred to as a multi-agent system (MAS) or platform. In IM, where there are users, in a MAS there are the agents; where there is a user directory, there is an agent directory; where there is a browseable components directory, there is a directory facilitator, and so on. From a certain point of view, one could say that agents behave as users that send or receive messages and make use of the resources and services of the platform.

When building a multi-agent platform, most of the design and implementation effort is put in the message transport mechanism. If an IM technology like Jabber is used, this *problem* is already solved. This model also simplifies the location issues of other users. The same user can connect from different locations without having to change addresses, the Instant Messaging server solves this.

Jabber is the ideal candidate to undergo this adaptation since it is standard, extremely adaptable, free, and has all the advantages and features presented in the previous section.

3.2 Presence Notification

Presence notification is one of the most useful features that Jabber provides. It is based on the Contacts List system. Contacts List is a mechanism through which a user can manage a list of *known friends* (called *roster*) to know at any time what the current status of any of the contacts is. Presence Notification allows a user to change its state in the network (e.g. *'Available'*, *'Busy'*, *'Don't disturb'*, ...) to notify its contacts of its availability.

When a user changes its current status, all the other entities who share a bond with the user are automatically notified. An entity status usually means its availability and readiness to engage in a communication, but it is not closed to a short predefined list. Entities may define their own status and their meanings.

Two or more Jabber entities can be bonded (or *subscribed*) to each other. Entities who share a bond can make use of presence notification as described above. In order to form a bond, two entities must agree in a simple negotiation process that can be automated (–see Figure 1).

This simple and powerful system is useful to know when a contact is online and you can send messages to him/her. Otherwise, the contact is offline and a message sent to him/her will be stored in the server (so it will not be read in real-time).

Presence notification can be used for agent communication and Multi-Agent System platform communication. A *heartbeat pulse* (i.e., the ability for an entity to know when a bonded entity is online or not) can be built over this mechanism. This eliminates the need for a *'Ping'* service in the agents or in the platform, as all of them can be bonded to each other or to a hypothetical *central* AMS-like agent that can control the life-cycle of the rest of agents.

Bonds can also be used by agents to form *social circles*, that is, groups of agents that are aware of each other's presence and status. This eliminates the need for making several queries to a central *white pages* service or *yellow pages*

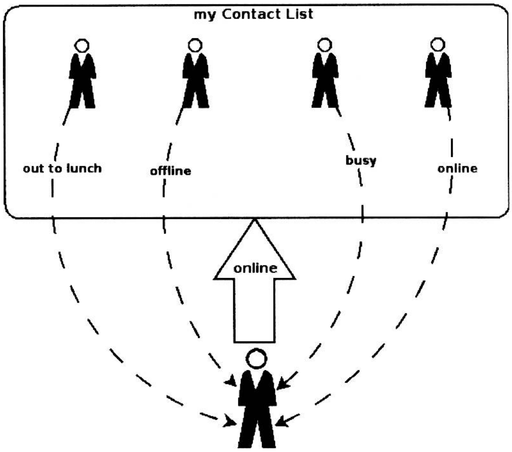

Fig. 1. Presence Notification

service to find out the availability of agents and services and, in the end, improves the general platform throughput.

3.3 Multi-User Conference

Another interesting Jabber feature is Multi-User Conference (MUC, in short). Jabber offers public conversation channels where users can join and make conversations with more than one user at the same time. These channels can be created by any entity (with an authorization in the server) and can be protected using a password, so only the entities that know the password can enter. A channel creator (or *administrator*) can also add or remove permissions to the entities that share a channel, such as the right to *speak* in it (–see Figure 2).

All these MUC features can be used to create forums dynamically for agents to connect to when performing some multi-agent activity. For instance, in a virtual auction scenario performed by agents, an agent playing the auctioneer role can create a password-protected channel and give the password only to previously certified agents. Then, in the channel, the auctioneer can give the right to speak only to agents who are going to play the bidder role, leaving the rest of agents in spectator mode only. Once the auction starts, every time a bidder wants to place a bid it just needs to *'speak'* in the channel, and all the other bidders and the auctioneer will know the bid at the same time.

MUC channels can also be used for more useful purposes. A simple method to send broadcasting announcements would be by sending a message to an appropriate chatroom. Every agent connected to that chatroom would receive the broadcast transparently. These chatrooms can be used to broadcast public platform information or to manage selected distribution lists. As an example imagine an scenario where a group of agents want to be notified when a particular

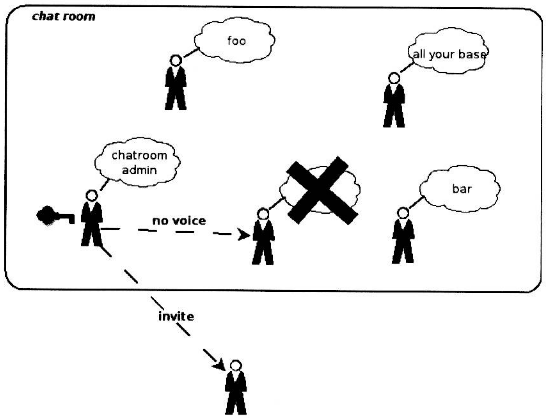

Fig. 2. Multi-User Conference

service is available. Thanks to Multi-User Conference mechanism, every agent that wants to be notified simply joins the chatroom associated with the service and when the service provider wants to announce the service availability sends a message to the chatroom. Note that the subscription list is automatically managed by the chatroom. Of course, this example does not replace the search service of the Directory Facilitator, it provides a new method similar to mailing distribution lists.

Using this powerful Jabber mechanism more MUC uses are quickly developed for agent communication improvement like federations, coalitions, hierarchies, etc. Also complex interaction protocols, like auctions, can be easily built with these facilities.

3.4 Distributed Network

As mentioned above, Jabber is decentralized by nature. Therefore, a Jabber user does not only choose a username, but also the server where the account will be created. What could at first seem to be a usability disadvantage, is one of the main advantages of Jabber as opposed to other IM systems.

For an agent, this means it can retain the same contact address even if it moves through different hosts, networks or even platforms. For a multi-agent platform, this feature provides several advantages. Let's see some aspects of this feature and their potential impact on an agent platform:

- Workload balance: Since there are servers distributed everywhere, divided by geography, by theme or by provider (university, city council, Internet provider...), the network workload generated by the users tends to distribute itself among all of them. In addition, some components of a Jabber server (users directory, network bridges, etc ...) can be executed in a different host than the one running the server itself, making the distribution better.