Inform!

The Newsletter of the Foundation for Intelligent Physical Agents

Volume 2 Issue 2

June 2001

Report of London Meeting

The 21st FIPA meeting was held April 2-6, 2001 at Imperial College in London, England. Work on FIPA specifications was continued by the established technical committees (TCs) as follows:

TC Agreement Management: Describing and defining service level agreements; enhancement of the current agent management specifications with configuration facilities.

TC Architecture: Describing and locating services and agents; establishment of policies (permissions and obligations).

TC Gateways: Releasing a Preliminary specification of an ontology of devices.

Work on applications of FIPA technology was continued by the established work groups (WGs) as follows:

WG AgentCities: Dissemination of information about current AgentCities projects (80 organizations worldwide, 8 different interoperating platforms) as well as planning of the next work to be carried out in FIPA.

WG Product Design and Manufacturing: Discussions in the areas of supply-chain, planning & scheduling, and control systems; active relationship with the holonic manufacturing society. (See Page 3.)

Work in the Special Interest Groups continued, in particular in developing workplans for Ontology and Security.

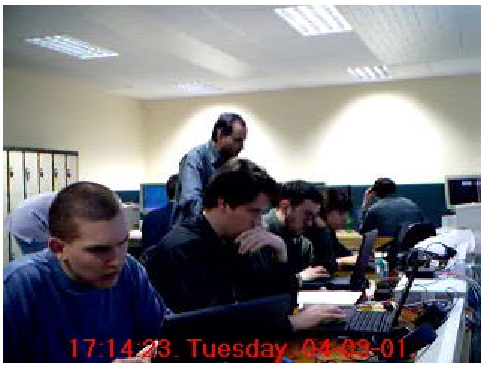
The week was highlighted with a comprehensive workshop with leaders of the multi-agent system community (report on Page 2), as well as with the successful continuation of the interoperability trials initiated at the 12th meeting in Seoul, Korea (full story below).

More detailed information about the results of the meeting can be found under www.fipa.org/activities/london2001.html and the individual committee web pages under www.fipa.org/activities.

D. Steiner, FIPA President

FIPA Interoperability in Action: the Bake-off

At the 21st FIPA meeting, last April in London, Imperial College hosted a bake-off between agent platforms based on the FIPA specifications. The goal of this event was crucial to FIPA: testing interoperability, checking if the specs actually promote and facilitate end-to-end inter-working. On the other hand "interoperability is what standards are all about"! As the Webster's Dictionary defines, a bake-off is a "baking contest, especially among amateur cooks, in which entries must be prepared and baked within a stipulated time" [http://www.etsi.org/bake-off/].



Three of the most known and used agent platforms sent their "cooks" to participate to the event: JADE [http://sharon.cselt.it/projects/jade], FIPA-OS [http://fipa-os.sourceforge.net], and ZEUS [http://www.labs.bt.com/projects/agents/zeus]. EPFL also participated by testing its implementa-

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News in Brief

FIPA members will be voting on the continuation of FIPA beyond its initial 5-year term on July 18, 2001. Look for the outcome of the vote in the next issue of FIPA Inform!

The next FIPA meetings take place July 23-27, 2001 in Sendai, Japan; October 15-19, 2001 near New York City or Boston, USA; and February 11-15, 2002 in Lausanne, Switzerland. See http://www.fipa.org/activities/meetings.html for more details.

The University of Helsinki is developing a FIPA-compliant, small-footprint agent platform called MicroFIPA-OS, for Personal Java-compatible, small devices such as PDAs. MicroFIPA-OS is based on FIPA-OS (http://fipa-os.sourceforge.net), and is being developed in the context of the EU project CRUMPET (IST-1999-20147). The first experimental release of MicroFIPA-OS was made available as Open Source in May; a formal, documented release will be available in August. For more information, see http://www.cs.helsinki.fi/group/crumpet/.

Emorphia (provider of the open source FIPA implementation, FIPA-OS) has launched its new web site and a range of professional support and training packages for eCommerce, eMarkets, agent technology and specifically FIPA-OS. Emorphia has taught postgraduate courses for both industry and academia.

Visit www.emorphia.com for further details.

Inside this issue:

FIPA in a Nutshell

The Foundation for Intelligent Physical Agents (FIPA) was formed in 1996 with the remit of producing software standards to enable inter-working between heterogeneous interacting agents and agent-based systems. The communication of knowledge and meaning, 'semantics', is a very important aspect of distributed 'smart' systems. The possibilities of cooperation, competition and observation allow limited individual components (agents) to tackle problems as a group, based on the services at their disposal. Numerous agent systems have been produced through research and industrial work to address specific problems, but the full potential of agent systems can only be realised when arbitrary agents can interact. FIPA have produced standards for agent communication (based on speech act theory), management, and service discovery (yellow and white pages). FIPA specifications focus on the interfaces for agent communication, specific internal agent architectures are not mandated. A number of independent implementations of the speci-

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tion of the HTTP-based FIPA MTP (Message Transport Protocol). And, in a fair, friendly and athletic spirit and atmosphere, the cooks worked hard 24 hours x 5 days (since Sunday to Thursday) to prepare their specialties and produce the following very high-quality achievements.

Ten FIPA specifications were used and tested including Agent Management, Message Transport Service, MTP for IIOP and HTTP, Agent Communication Language Parameters, String and bit-efficient ACL Encoding, the FIPA-SLO content language, and the FIPA-Request and FIPA-Query Interaction Protocols. Several different tests were performed: sending & receiving ACL messages over different MTPs and different encodings, conducting full conversations in the scope of Interaction Protocols, communicating and requesting services to the remote DFs and AMSs, including searching for remote agents and remote agent descriptions and federating remote DFs. A presentation was also given on the last day of the event demonstrating to FIPA members the interoperability of the three platforms.

As a result, a list of minor issues were identified in the FIPA specs (and reported back to FIPA [http://www.fipa.org/docs/input/f-in-00026/]) where ambiguity or effectiveness might be improved and a workplan for producing a set of conformance tests was also submitted to FIPA [http://www.fipa.org/docs/input/f-in-00028/]. Some platforms had a more strict view on the standard, others were more lenient; some platforms had support for these tests already integrated in their management tools, others needed some manual support but the most important result is that they all successfully interoperated based on the FIPA specs! Based on these considerations, and considering that the requirements of FIPA were met, the bake-off group proposed to FIPA the promotion of the ten tested specifications to 'standard' status.

FIPA developed the experimental specs and encouraged their use, member companies have proved they facilitate interoperability, now the FIPA community waits for FIPA to promote the specs to 'standard' status.

F. Bellifemine

FIPA London Workshop

Increasingly, software systems, agents if you will, are meeting and interacting with each other on the public Internet. This has enormous potential benefits for increased interworking in business, society and commerce, for example virtual enterprises (especially across organizational boundaries), connected communities, and shopping portals.

However, this requires a substantial rethink on the part of programmers, businesses and designers. If an individual or organization buys, rents, or licenses - and thereby, in some sense owns - an agent, that is potentially going to be spending their money, using (or letting others use) their rights, and making other public commitments on their behalf, then they had better be sure that it isn't a "double agent"! The issue of security now involves higher-level requirements for integrity, including liability, responsibility and privacy. These requirements arguably place increased demands on our agent-based systems and standards. To initiate discussion, FIPA organized and presented, during its 21st Meeting in London, a public workshop with invited speakers asked to address a range of issues concerning 'appropriate' behavior for autonomous agents. The talks in this workshop accordingly addressed the impact on communication (constitutive acts and negotiation), correctness (internet trust and verification) and contracts (automatic generation and legal reasoning) in this new setting. Talks were given by Prof. Andrew Jones of University of Oslo on *ACL: Perspectives and Prospects*; Prof. Nick Jennings of University of Southhampton on *Negotiation*; Prof. Morris Sloman of Imperial College on *Trust on the Internet*; Prof. Mike Wooldridge of University of Liverpool on *Verification*; Prof. Jean Sallantin of University of Montpellier on *Automatic Contract Generation*; and Prof. Marek Sergot of Imperial College on *Deontic Logic and Legal Reasoning.*

We highlight two of the talks as representative of the high quality of the presentations: Professor Jones analysed some of the weaknesses of ACL semantics from the perspective of the philosophy of language. He was then able to propose an alternative account, which focused on the use of signaling acts to convey conventional meanings. The logical foundations of this work were presented, based on modal operators of norms (ideality, brings-about, obligation, and can (three types)), and a conditional connective 'counts as' (relativised to a society or e-institution). This can provide a new semantic framework for FIPA-ACL which turns out to have much in common with the way in which "speech acts" are currently used by designers and implementers of agent systems. Professor Sergot's primary concern was how interactions between agents created some form of relation between the human entities that were represented by the agents. In particular, where these interactions involved some kind of commerce, what was exchanged was increasingly not a physical 'good', but a legal position to exploit a digital right, but that the legal position was underspecified according to current practice. Therefore the need to specify ways of identifying responsibility and liability, and most importantly of enforcement, was critical in future e-commerce.

In many ways, this workshop can be seen as a follow up to the workshop held at the Dublin meeting in July, 1998, which focused on ethical behavior for autonomous agents. The talks at this workshop showed that significant progress has been made to formalising such notions for computational processes, but international standards are extremely important for regulation of commerce and protection of rights. FIPA can therefore have a vital impact in this domain.

J. Bradshaw and J. Pitt

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fications have been built, some as open source; these have been used to validate the standards. Further details about FIPA, including the current specification documents, details of available implementations and details of how to join can be found at http://www.fipa.org/. FIPA is a non-profit organization and boasts a membership that includes many of the world's biggest Technology, Media, and Telecommunications (TMT) companies. FIPA undertakes its work at quarterly meetings (funded primarily by membership fees) in an open, collaborative manner.

FIPA Technology Overview: Holonic Enterprise

In today's E-conomy the only chance for prosperity is to exploit optimally the emerging technologies that are the backbone of a new infrastructure facilitating strategic partnerships among cyber-highway enabled participants. The FIPA-Product Design and Manufacturing Work Group merges latest results obtained by the Holonic Manufacturing Systems (HMS) Consortium with latest developed standards for platform interoperability released by the FIPA to propose a novel E-business model: the Holonic E-nterprise. A holonic enterprise is a holarchy of collaborative enterprises, where the enterprise is regarded as a holon. Including the E-marketplace and E-factory as submodels this new paradigm links the three levels of a global collaborative organization (inter-enterprise; intra-enterprise and machine level) to build a web-centric ecosystem partnership in which the workflow is harmoniously managed. The Holonic Enterprise extends both the HMS and FIPA models. On one side it extends the holonic manufacturing paradigm with one top level, the inter-enterprise one. On the other side it extends the multi-agent system (MAS) paradigm, and by this the FIPA architecture, to the hardware (physical machine) level. One main characteristic of a holon is its multiple granularity. The term holon was coined by Artur Koestler to denominate entities that exhibit simultaneously both autonomy and cooperation capabilities which demand balance of the contradictory forces that define each of these properties on a behavioral level.

A holonic enterprise has three levels of granularity:

1. Global inter-enterprise collaborative level

At this level several holon-enterprises cluster into a collaborative holarchy to produce a product or service. Traditionally this level was regarded as a mostly static chain of customers and suppliers. In the holonic enterprise the supply chain paradigm is replaced by the collaborative holarchy paradigm (Fig. 1). The dynamic collaborative holarchy can cope with unexpected disturbances through on-line re-configuration of the open system it represents. It provides on-line order distribution across the available partners as well as deployment mechanisms that ensure real-time order error reporting and on-demand order tracking.

2. Intra-enterprise level

Once each enterprise has undertaken responsibility for the assigned part of the work, it has to organize in turn its own internal resources to deliver on time. Planning and dynamic scheduling of resources at this level enable functional reconfiguration and flexibility via (re) selecting functional units, (re)assigning their locations, and (re)defining their interconnections. Re-configuration of schedules to cope with new orders or unexpected disturbances (e.g. when a machine breaks) is enabled through re-clustering of the agents representing the actual resources of the enterprise. The main criteria for resource (re)allocation when (re)configuring the schedules are related to cost minimization achieved via multi-criteria optimization.

3. Machine (physical agent) level

This level is concerned with the distributed control of the physical machines that actually perform the work. To enable agile manufacturing through the deployment of self-reconfiguring, each machine is cloned as an agent that abstracts those parameters needed for the configuration of the holonic control system managing the distributed production.

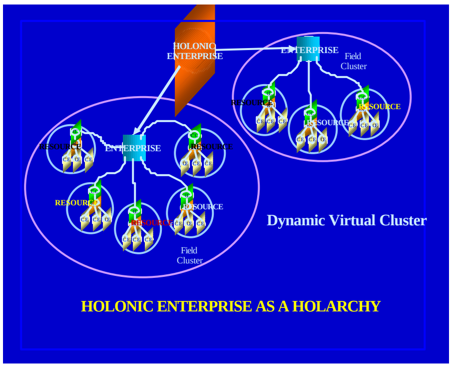
Patterns of holonic collaboration

The common mechanisms that characterize the collaborative information eco-system created by the three levels of a holonic enterprise follow the following design patterns for adaptive multi-agent systems identified (Fig. 2).

Metamorphic Architecture Pattern**.** The overall architecture of the Holonic Enterprise builds on this pattern that replicates at all levels.

This pattern works by synergetic integration of two other patterns:

Dynamic Virtual Clustering configured to minimize cost and enabling for flexible, re-configurable structures. At all levels of the holonic enterprise, task propagation occurs by a process of virtual cluster (or holarchy) formation. This pattern is facilitated by the general layered architecture of the holonic enterprise. Each level de-



scribed previously is divided into a number of autonomous layers that appear to interact through an API (application programming interface). Code is run asynchronously on these layers, providing functional separation between the layers.

Mediator Agent Pattern supporting the decision-making process that creates and (re)-configures the collaborative cluster of enterprises.

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TECHNOLOGY OVERVIEW: Peer-to-Peer Computing

The term "Peer-to-Peer" (P2P) computing has both benefited and suffered from popularization by the media, analysts, and companies hoping to profit from the ensuing hype. Even though P2P actually refers to a well-established computing *architecture* (a la Client-Server), it was recently misused for categorizing *applications*. While the use of a P2P architecture made the notable music file-sharing service Napster technologically feasible, other legal problems arose. However, this was not a direct result of using a P2P architecture. The much sought after "killer application" of P2P makes as little sense as a killer application for Client-Server computing. As often occurs with hype (Artificial Intelligence in the mid-80s and the recent dot-com implosion spring immediately to my mind), the resultant de-hyping unnecessarily leaves scores of victims and scars in its wake.

A P2P computing architecture clearly brings advantages of inherent scalability and reliability over that of centralized architectures; this was well demonstrated by Napster. As Napster and other recent P2P systems didn't incorporate control and security, many people assume that these are inherent flaws in a P2P architecture. However, control and security can be incorporated as easily (or as hard) into a P2P system as in a centralized system – it just needs to be done correctly and carefully.

As FIPA's goal is to promote interoperability among autonomous systems, FIPA's work clearly falls within the peer-to-peer category. Indeed, FIPA has already addressed many of the issues faced by P2P architectures such as dynamic discovery and dealing with unavailable or unreliable processes. FIPA's underlying architecture supports the various messaging protocols and data representation formats being introduced by other P2P efforts. As such, FIPA can become a major factor in enabling next generation P2P systems, going beyond file sharing and distributed computing.

D. Steiner

FIPA Member Profile: Fujitsu

The Network Agent Research (NAR) group is part of Fujitsu Laboratories of America and was formed in September 1997 to research and develop new and novel technologies for supporting applications that are distributed across globally interconnected networks, such as the Internet. Based in the heart of Silicon Valley, California, FLA is a wholly owned subsidiary of Fujitsu Laboratories Limited, Japan, and employs around 60 people involved in advanced CAD software development and research, optical hardware research and internet protocol collaboration and research. The NAR group is currently involved in the following agent-based activities:

* Developing next generation agent-based distributed programming languages and internet-based communications mechanisms.
* Being a partner in the EU Agentcities project to develop the next generation of service-based representation and interoperability.
* Leading the Java Agent Services project, a Sun Java Community Process standard for interoperation amongst Java agents.

Fujitsu has been a member in FIPA since 1998 and has made significant contributions to most of the FIPA specifications, including interaction protocols, communicative acts, FIPA ACL, agent management, agent message transport and the Abstract Architecture. More recently, the NAR group members are involved in FIPA specifications for domains and policies, agent configuration management, agreements between agents and ontology representations and usages.

More information can be found at: http://www.nar.fujitsulabs.com/

J. Dale

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To abstract those characteristics of the entities in each cluster that are relevant for the particular collaboration at each level we use the Partial Cloning Pattern. This pattern defines which of the enterprise's characteristics (attributes and functionality) we need to abstract into agents at each level when modeling the holonic enterprise as a collaborative multi-agent system.

The workflow coordination throughout the collaborative ecosystem is managed by the mediator agent via the Task Decomposition-Distribution Pattern. This pattern is enhanced with capability to distribute harmoniously among the participants, the overall task assigned to the collaborative holon, at each level. The main mechanisms by which this pattern works are:

task distribution among the cluster's entities (outside-in view from the mediator "down" into each collaborative partner at that level) and task deployment within each entity (inside-out view – from the entity, regarded as a holon with distributed resources available to it for accomplishing the assigned task, to the mediator).

Propagation of the task decomposition-distribution pattern throughout the granular levels of the holonic enterprise requires two kind of ontologies to enable 'inter-entity' communication, which define an Ontology Pattern. This consists of two kind of ontologies, namely for 'peer-to-peer' communication at each level (that is 'inter-agent' communication among entities that form a cluster); and for 'inter-level' communication that enables deployment of tasks assigned at higher levels (by the mediator) on lower level clusters of resources.

Although they work at each level to manage the flow of information and materials within the holonic enterprise these patterns have specific particularities within each level of the collaborative holarchy. The purpose of our work is to identify these particularities and clearly define the policies and services supported by the patterns as well as the mechanisms that would enable their implementation within each level.

M. Ulieru

FIPA Member Profile: EPFL

The Artificial Intelligence Lab (LIA) at EPFL was founded in 1987 and currently has around 20 researchers working in diverse areas such as Natural Language Processing, Constraint Satisfaction, Case Based Reasoning and Agent Technology.

EPFL has been a member of FIPA since FIPA was founded in 1996 and has been a major contributor in the areas of Human Agent Interfaces, Agent Communication, Agent Management and Message Transport.

EPFL's main areas of activity in the agent's field include:

Agent applications in communications networks: with a focus on the application of constraint satisfaction techniques, coordination and organisation paradigms, negotiation and market based systems.

Agents in Electronic Markets: with the implementation of a FIPA compliant agent-based auction house for selling IP bandwidth.

Agents in Distributed CSP: distributed constraint satisfaction techniques for enabling coordination between self-interested agents whilst safeguarding private data and preventing false declarations of constraints.

EPFL also teaches agent related courses at both undergraduate and postgraduate level. Looking towards to the future, EPFL's main areas of FIPA related activities are:

Security: improving trust and security mechanisms in agent-based frameworks with involvement in the FIPA Security Working Group.

Ontology: including involvement in the FIPA Ontology SIG and co-chairing the first international workshop on Ontologies in Agent Systems (OAS2001) held in conjunction with Autonomous Agents 2001 on the 29th May, 2001 in Montreal Canada.

Agreement, Semantics and Communication Models: supporting re-working of FIPA communication models to support commitments and binding agent agreements between agents.

Agentcities: EPFL has been heavily involved in the development of the Agentcities initiative which aims to deploy a worldwide, publicly available network of agent platforms and services. LIA's involvement includes the development of tools, involvement in key projects (such as the new European IST projects) and playing a coordinating role.

Research areas which will form a focus for LIA's activities include agent based business services (financial services, transactions, markets), robust infrastructures and communication models for open heterogeneous agent environments such as the Agentcities network, and coordination for the composition of complex agent based services.

More information can be found at:
http://www.agentcities.org/
http://liawww.epfl.ch/
http://www.autonomousagents.org/2001/oas/

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