



inform!

Editorial

Something for everyone; that's my goal for this first issue of *inform!* For the complete beginner there is a glossary ... what the heck is an agent anyway? Still confused? Then read 'Agent-based UML'. For the agent aficionado who is unaware of FIPA, the introductory section will help and the offer of open source code may tempt. Those of you that are business-minded take a look at the e-commerce articles: 'FIPA M-Commerce' and 'Profile of a Revolutionary'. Finally, if you are a FIPA member then take a nostalgic look back at our close encounter with the Millennium Dome and say 'we were there!'. ROB HADINGHAM

FIPA and Intelligent Agents

Intelligent agent technology will have a significant impact on the shape of the global information society over the next millennium. This branch of systems engineering is rapidly becoming a viable and exploitable technology.

The highly interactive nature of multi-agent systems points to the need for consensus on agent interfaces in order to support interoperability between different agent systems. The completion and adoption of such a standard is a prerequisite to the commercialization and successful exploitation of intelligent agent technology.

FIPA is an international organization dedicated to promoting the commercial application of intelligent agent technology by openly developing specifications supporting interoperability for agents and agent-based services.

FIPA members are individually and collectively committed to open competition in the development of agent-based applications, services and equipment. Organizations that collaborate through their FIPA activities include many of the large commercial Computing and Telecom companies, and prominent universities from around the globe. Membership in FIPA is open to any individual, partnership, corporation, governmental body, or international organization without restriction.

FIPA is a non-profit association registered in Geneva, Switzerland. The members of FIPA represent in excess of

50 organizations worldwide. Further information about FIPA, membership information, FIPA specifications, and upcoming meetings may be found at www.fipa.org. DONALD STEINER, PAUL O'BRIEN



FIPA M-Commerce

Key enabling technologies for electronic and mobile commerce include HTTP and data encoding mechanisms, such as XML (eXtensible Markup Language). Numerous companies, including Microsoft and Oracle are committed to supporting XML in future product releases due to its ability to support interoperable data encodings. The ability to exchange information from heterogeneous environments is crucial when attempting to construct commerce systems that potentially integrate products from numerous vendors (e.g. integrating backoffice systems with web portals). XML technology is also highly applicable to FIPA technologies, particularly when you consider the number of research activities involving developing trial e-commerce systems using FIPA agent technology. One notable product using FIPA technologies in the e-Commerce domain is the EU project FACTS (see 'FACTS validates FIPA Standards').

Within FACTS, mechanisms were developed to use RDF for encoding the content expressions exchanged between agents. Proposals have also been made on how XML and RDF (Resource Description Framework) could be used as alternative syntaxes for the FIPA ACL. Further work within the FACTS project has involved use of the WAP (Wireless Application Protocol) which is an application environment and set of communication protocols designed to allow the expedient development of

applications and services that operate over wireless networks. WAP makes use of existing Internet standards such as XML to enable Internet access to small footprint devices, such as mobile phones. The FACTS project has developed a mechanism for translating ACL messages to and from WAP messages enabling WAP devices to be supported by FIPA Agent-enabled applications.

The future is bright and will almost certainly involve FIPA, XML, RDF and WAP. FIPA will ensure that these technologies are harmoniously combined to enable the development of applications for roaming users, not least those involved in mobile commerce.

PHIL BUCKLE

Open Source for Open Standards

So you want to start experimenting with FIPA software... what are your barriers to entry? Well, they are substantially lower now that FIPA compatible software has come to term. You have several options, most of which are now provided as open source code. Open source allows anyone to see and change the source code. Like all things, there are pros and cons. The largest benefit of open source is that many people see the code, under this level of scrutiny many more bugs can be discovered. The biggest drawback, however, is the co-ordination required when many people are changing the code simultaneously; different open source initiatives cope with this in different ways. Another thing to look out for is the licensing terms, some projects are open source for non-commercial use only - this could affect your plans for exploitation. The most successful open source projects include Linux, and IBM's Apache web server.

What are the benefits of open source from a developer perspective? The benefits are in terms of quality and access; the quality of a mature open source development is, arguably, better than that of traditionally developed software due to less bugs. Good access means that a developer can really get inside the code, understand what it is doing, and customize or improve on it; following the open source spirit means that such improvements are fed back in to the open source community.

The first publicly available FIPA implementation, **FIPA-OS**, came from Nortel Networks and was released as open source in October 1999. In the first three months over 200 developers from around the world have downloaded the software. The FIPA-OS license provides a worldwide, royalty-free, non-exclusive license, subject to third party intellectual property rights. The third released 'easy-install' Java 1.2 version of FIPA-OS is now available from www.nortelnetworks.com/fipa-os.

The **ZEUS Agent Building Toolkit** is BT Labs award winning integrated environment for the rapid development of collaborative agent applications. It makes good use of graphical programming, debugging, and visualization tools, and sets a high standard for integrated GUI-based agent development environments. The ZEUS toolkit is entirely implemented in Java (JDK2) and will run on all major hardware platforms. It is FIPA-ACL compliant and has been undergoing evaluation by researchers and engineers from 30 organizations around the world. ZEUS has been employed successfully as the underlying technology in a number of BT's agent-based R&D projects. BT encourage Agent workers to join the existing ZEUS user community. ZEUS source code is available from www.labs.bt.com/projects/agents/zeus/.

Source code and an interoperability testing capability is also available from the Public Agent Platform at Comtec, details can be found at www.fipa.org/glointe.htm.

JADE from CSELT has just announced a public open source distribution under the LGPL license. Jade runs on Java 1.2 and has been used on a number of European projects. Jade source code is available from <http://sharon.csel.it/projects/jade>.

The Intelligent and Interactive System group at Imperial College, as part of its CASBAh (Common Agent Service Brokering Architecture) project, has announced an initiative called **FIPA-NET** to assist in locating and connecting to service providers in a FIPA agent society. FIPA-NET will consist of a publicly accessible Internet "yellow-page" service for agents, which will act as a node for Federated Directory Facilitators.

A number of other organizations have declared an intent to make some of their software available as open source, this includes a platform from Fujitsu, and TIHERA from the U.S. Navy. If open source is not to your taste then take a closer look at **Grasshopper** from IKV++ at www.ikv.de/. Look for future *inform!* articles for more details.

ROB HADINGHAM

FIPA @ The Millennium Dome

The 16th FIPA meeting was held in London in January, hosted by BT. The traditional social event took place at the newly opened Millennium Dome. Richard Nicol, BT's Head of Research, recapped FIPA's brief history since its conception in 1996. The first specifications were produced in 1997, these were tested and extended in 1998. FIPA software became publicly available in 1999 together with significant advances in the interoperability specifications which will be consolidated in 2000. The objectives for 2000 include reaching the original target of 200 member organizations; FIPA currently has in excess of 50. The turn of the Millennium is a landmark for FIPA, commercial exploitation is the next



major milestone.

Donald Steiner, President of FIPA, continued the 'turning point' theme by congratulating the members on their patience as processes within FIPA are streamlined for the new Millennium. With the introduction of a new technical authority in FIPA, the FIPA Architecture Board (fab@fipa.org) we can look forward to a new level of professionalism and consistency between the FIPA specifications. The specs themselves will now have a status corresponding to the lifecycle: Preliminary, Experimental, Standard, Deprecated, and Obsolete. The specs written in 1999 will now be adapted and published according to the new lifecycle, with some Preliminary specifications available from February. Watch out for these documents, they will include the latest on Message Transport, Interaction Protocols, Content Language Library, Abstract Architecture, and Nomadic Application Support (FIPA for the Wireless Internet and WAP).

Workplans for new work are expected over the coming weeks before the next FIPA meeting in Portugal, these will include topics like E-commerce, Business-to-Business, Security, Java Reification, Open Source, Agent Configuration Management, Agent Mobility, and Gateways. Anyone wishing to cooperate on these or other workplans should correspond well in advance of the next meeting.

Other highlights of the 16th FIPA meeting included further open source

announcements (see 'Open Source for Open Standards') and a demonstration session, with demos from ÆGIS, Broadcom, BT, CSELT, Fujitsu, Nortel Networks, and the University of Helsinki (see 'London Premiere for FIPA Demonstrations'). Morris Sloman (Imperial College) as guest speaker presented a talk on Policies and agents - this is another candidate for future FIPA workplans.

Hiroki Suguri (Comtec) reached the end of his tenure as FIPA Director, and will now take on the role as Chair of the Fipa Architecture Board. The appointed members of the FAB are Fabio Bellifemine, Thierry Bouron, Phil Buckle, Jonathan Dale, and David Levine. The Millennium lineup for the FIPA Board of Directors (elected in Japan last October) is Donald Steiner (President), Frank McCabe (VP), together with Geoff Arnold, Bernard Burg, Rob Hadingham, Kyoshi Kogure, and Richard Nicol. The new Boards looks forward to driving FIPA into the new Millennium!

Finally, a brief word about the newest of FIPA's sub-groups - the Image Committee (inform@fipa.org). This group will undertake to transform the public and community knowledge of FIPA - initially by improving the web presence, sponsoring events, and producing and distributing this newsletter.

FIPA invites its membership and contributors to the FIPA process to its next meeting, April 3-7 in Lisbon, Portugal - to be hosted by ADETTI.

ROB HADINGHAM

Agent-based UML (AUML)

With the OMG's Analysis and Design Taskforce (ADTF), an object-oriented (OO) standard now exists for: a common meta-model for maintaining OO A&D knowledge, a technique for exchanging this knowledge, and lastly a suggested notation for expressing OO A&D knowledge. A few years ago, such a facility was hoped for and dreamed about—but hardly considered feasible. Now there is a de jure standard, called the Unified Modeling Language (UML), that defines the core concepts for OO analysis and design and a prescribed set of diagrams for communicating these concepts

However, UML is insufficient for modeling agents and agent-based systems. Compared to objects, agents are active. Based on internal states, their activities include goals and conditions that guide the execution of defined tasks. While objects need outside control to execute their methods, agents know the conditions and intended effects of their actions and hence take responsibility for their needs. Furthermore, agents act

both alone and with other agents. Multiagent systems can often resemble a social community of interdependent members that act individually. No formalism, then, yet exists to sufficiently specify agent-based system development. To employ agent-based programming, a specification technique must support the whole software engineering process—from planning, through analysis and design, and finally to system construction, transition, and maintenance.

Nevertheless, while agents and objects have different requirements, a considerable overlap in modeling requirements does exist. Currently, FIPA and the OMG's Agent Work Group are examining ways of extending UML to express agent-based constructs and are proposing an agent-based UML (AUML). While such a situation will not solve all our problems, it will reduce the Babel-ization surrounding agent representation. Then, we can then put more effort into what we're communicating—and not so much into how to communicate it. To participate in the AUML effort or to obtain more information, visit www.jamesodell.com.

JIM ODELL

London Premiere for FIPA Demonstrations

London presented a great opportunity for FIPA members to demonstrate some of their latest work on software agent applications. Such events are increasingly important in developing an awareness and confidence in this new technology, and also complement FIPA's drive towards the commercialization of agents via its standards. In all, eight demonstrations were given, representing a mix of innovative applications plus tools and platforms for supporting such applications.

Two agent platforms were demonstrated, Nortel Network's Phil Buckle presented FIPA-OS and Fabio Bellifemine showed CSELT's JADE. BT's Lyndon Lee demonstrated the ZEUS Agent Building Toolkit. Refer to the 'Open Source for Open Standards' article for more details on these initiatives.

Stefano Campadello from the Mobile Computing Laboratory, University of Helsinki showed how their agent system supported nomadic users and applications. Their prototype, using a simulated mobile network, was able to predict near-time future quality of service (QoS) and adapt to changes in QoS requirements. An application particularly relevant to the impending growth in mobile data.

BT & Fujitsu demonstrated the latest results of a joint project, IDIoMS (Intelligent Distributed Information

Management System). IDIoMS provides a comprehensive set of tools for personalized information delivery. The advanced distributed information management technology was provided by Fujitsu Laboratories' Open Agent Middleware platform, whilst personalized information management and delivery was performed by BT's Personal Agent Framework.

The FACTS Personal Travel Market application and ASL (Agent Service Layer) were demonstrated by Richard Evans and Broadcom colleagues. ASL is a FIPA compliant platform developed at Broadcom. During February, FACTS will be hosting a workshop where all three of its applications will be demonstrated, (see www.labs.bt.com/profsoc/facts/).

Agent workflow, demonstrated by Simon Thompson from BT, is a new approach to managing distributed processes and volume work activities. It complements the traditional coordination role of workflow with the collaborative abilities of software agents. The prototype demonstrates an agent layer managing resource distribution over a commercial workflow engine. Agent workflow uses the ZEUS toolkit.



And finally, BT's Brian Odgers demonstrated the latest results of SAMBA (Software Agents for Mediating Business Activities). SAMBA uses agent-based negotiation strategies to allow remote workers to control their work activities in a decentralized manner. This system could be used to enable workers to set work preferences, trade jobs, share knowledge. For further information on SAMBA or Agent Workflow please visit www.labs.bt.com/projects/ibsr/body.htm.

In all, the FIPA demonstrations gave an excellent insight into the range of potential applications for agent technology. They also highlighted the need for commercial standards and the relevance of FIPA in making agents a commercial reality.

PAUL O'BRIEN

CoABS

The Control of Agent Based Systems (CoABS) program is sponsored by The Defense Advanced Research Projects Agency (DARPA) and the Air Force Research Laboratory (AFRL). The

purpose of CoABS is to explore enabling technologies for the integration of architectures and distributed systems of agents, objects, and legacy systems.

The CoABS Grid is an architecture for achieving these goals. A Grid prototype is being developed in an iterative manner, to validate the architecture. The Grid provides access to shared protocols and ontologies, mechanisms for describing agent capabilities and needs, and services that support interoperability among agents at flexible levels of semantics, all distributed across a network infrastructure.

The current grid prototype is implemented in Java, uses Sun's Jini Connection Technology, and is FIPA-ACL compliant. The FIPA Agent Management Specification has been mapped to registry methods within the CoABS Grid, and many of the FIPA Agent Management Objects have been mapped to Jini Entries. FIPA provides the semantic ACL and a theory of agency which is being used to specify event, instrumentation, security, and translation services.

Details on the CoABS program can be found at <http://coabs.globalinfotek.com>.

PHIL SAGE

FACTS Validates FIPA Standards

The business potential for agent-based computing is massive. Potential applications include network management, e-commerce, business process management, personal e-assistants and information/knowledge management. Agent technology covers this breadth because the basic paradigm mimics the organic structure of human societies. Thus pro-activity, learning, communication, collaboration, negotiation, etc. have all been demonstrated on FIPA-compatible autonomous entities behaving in heterogeneous societies by FACTS.

FACTS (FIPA Agent Communication Technologies and Services) is a European Community project, under the ACTS collaborative framework.

The FACTS validation demonstrators cover three different application areas: Audio-visual Broadcasting and Entertainment, Service Reservation and Provisioning, and E-commerce. Each application area has developed several distinct agents, which interact. In all, FACTS has used a total of five different agent platforms to validate inter-platform interoperability. Work in FACTS has identified areas of the original FIPA specifications that are open to misinterpretation and also features requiring new aspects. It has also built

confidence in the practical usability of the standards.

The audio-visual entertainment and broadcasting activity improves personal entertainment by helping users to select suitable programmes. The system architecture builds on an intermediary service acting as a broker between users and service providers, tailoring the programme guide to each user, by capturing and modelling user interests. From the user's viewpoint, natural language recognition and animated synthetic personality makes the user interface simpler and more adaptable, this is implemented by a dynamic composition of specialized software agents. This application was built with CSELT's JADE.

The Service Reservation and Provisioning application illustrates a possible world in which network and service providers trade their resources automatically using dynamic pricing and automatically negotiated Service Level Agreements, potentially supporting ad hoc relationships with competitors to ensure long term customer satisfaction. The implementation of this dynamic and competitive IP service provisioning application involves a number of FIPA compatible co-operating agent communities (based on heterogeneous agent platforms) that consist of Personal Communication agents, Service Provider agents and Network Provider agents. The platform built by GMD Fokus was used to seed the Grasshopper extension developed by IKV++. The platform developed by Nortel Networks, FIPA-OS, was released publicly in October 1999 as managed open source software.

The e-commerce application targets the area of travel markets; in most existing systems the satisfaction of constraints is left to the user. The FACTS Travel Market System allows automatic composition and decomposition of services and incorporates a business model. Three agents co-exist: a Personal Assistant to interface with the system; a Travel Broker to decompose and aggregate services and Travel Service Agents to provide data and services, e.g. timetables and hotel availability. Case Based Reasoning (CBR) enables user profiles to be learnt on-line. The broker dissects requests, obtains information on schedules, availability and prices and matches alternatives to business policy and user requirements. Wireless Access and secure payment mechanisms are included.

In building these demonstrators, FACTS members benefited from a tremendous reduction of the work that designers normally have to devote to interoperability. The integration phase was very short, simple and successful. FACTS partners are: Alcatel Bell,

Broadcom, BT, CNET, CSELT, KPN, GMD Fokus, Imperial College, ITC, NHK, Nortel Networks, and ONERA/CERT.

THE FACTS PROJECT

Spotlight!: [Profile of a Revolutionary](#) Manuel Aparicio, a former director of FIPA, began his career as the first Ph.D. hired to research in neurocomputing at IBM (1987). As Chief Scientist at the Center for Knowledge Management and Intelligent Agents, he co-founded IBM's research effort in intelligent agents leading to the development of their first commercial agents.

As advanced and viable as these and other agents are, they represent variations of agent-based learning coupled with associative database methods that are hampered by distribution, speed, parametric and, most notably, scaling limitations. They only aspire to old dreams of artificial intelligence. However, January 1999 marked the beginning of the end for these and other limitations that have frustrated computer scientists for decades.

Dr. Aparicio and his research partner, Jim Fleming, founded Saffron Technology Corporation and brought to fruition Saffron One, a profound, new Associative Memory engine that truly replicates certain human cerebellum processes and supports advanced agent technology.

While Saffron One, has broad practical potential, it will first be marketed for use in e-commerce to provide dialog and recommendation services, an application for which it's particularly suitable. This is true because, for example, Saffron One, learns non-linear relationships, yet stores them in a linear form; it is capable of scaling from massive Internet traffic down to wireless telephones; it provides truly personal Consumer Agents for each consumer along with personable and knowledgeable Sales Agents for unlimited product categories, each coordinated by Saffron Mediator; and, it is self-confident and context-sensitive. For further information visit www.saffrontech.com.

JOHN G. MACKIN

W in \$10000!

FIPA has launched a competition of applications utilizing FIPA agents. The competition is open to FIPA members as well as non-members. FIPA will award a prize of up to \$10,000 (US) to the developer of the most interesting and complete demonstration - as judged by the FIPA members.

The competition will take place at the April 2000 meeting of FIPA, in Portugal. Further information can be found at: www.fipa.org/competition.htm.

Glossary

Agent (or Autonomous Agent) - an autonomous component that combines one or more service capabilities into an integrated execution entity. An agent can communicate with other agents, software, and humans. In particular FIPA agents communicate declaratively.

Agent Communication Language (ACL) - a language with precisely defined syntax, semantics and pragmatics that is the basis of communication between independently designed and developed software agents.

Bot - a popular term for intelligent Internet agents.
Communicative Act (CA) - a special class of actions that correspond to the basic building blocks of dialogue between agents (e.g. Inform, Request, Propose, Refuse, Subscribe, etc.).

Content Language - The content of an agent message refers to whatever the communicative act applies. If, in general terms, the communicative act is considered as a sentence, then the content is the grammatical object of the sentence.

Conversation - An ongoing sequence of communicative acts exchanged between two (or more) agents relating to some ongoing topic of discourse.

Intelligent Agent - one which exhibits some degree of artificial intelligence.

Message - an individual unit of communication between two or more agents.

Mobile agent - one whose execution is not restricted to the Agent Platform where it was created; it can migrate to another agent platform. Mobility is not a mandatory agent attribute and discussions about agents should not assume that they are so equipped.

Ontology - An ontology is an explicit specification of the structure of a certain domain (for example, e-commerce, sport, manufacturing, etc.). An ontology includes a vocabulary for referring to a subject area, and a set of logical statements defining the constraints restricting the interpretation of the vocabulary.

Ontology sharing problem - The problem of ensuring that two agents that wish to converse do, in fact, share a common ontology for the domain of discourse.

Personalization - An agent's ability to take individual preferences and characteristics of users into account and adapt its behavior to suit these factors.

Protocol - A common pattern of conversations used to perform some generally useful task.

Speech Act Theory - derived from the linguistic analysis of human communication and is used as the basis for Agent Communication Languages.

Stationary agent - A stationary agent is one that executes only upon the agent platform where it was created; it influences remote actions by communicating its requests and needs to other software, agents, and people.

User agent - A user agent is one that interacts with, and on behalf of, a human user.

Wrapper agent - A wrapper agent is one that provides an interface to a non-agent or legacy system.

Agents on the Net

There are many agent resources on the Web, but in particular these three are worth mentioning as 'portals' to the rest. In-depth articles coming soon!

AgentLink: www.AgentLink.org/
AgentWeb: <http://agents.umbc.edu/>
Botspot: www.botspot.com/

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