ISSN 1465-3842

AGENTLINK NEWS 6

Europe's IST-funded Network of Excellence for agent-based computing

January 2001 www.agentlink.org

Features

Open Standards and Open Source for Agent-Based Systems
Bernard Burg, Jonathan Dale and Steven Willmott 2

The role of agents in business to business (B2B) electronic commerce
Steve Osborn 6

Let A Million Agents Bloom: Infohabitants and Universal Information EcoSystems - FET UIE Concertation Meeting, Imperial College, December 1st 2000
Jeremy Pitt 9

Project Reports

An Overview of the SSAHLA Project - Simulation based on Software Agents and the High Level Architecture
Zakaria Maamar 10

Agent-Based Social Simulation with JAM
Alexander Staller and Paolo Petta 12

Site Reports

The Intelligence, Agents and Multimedia Group at the University of Southampton
Michael Luck, Nick Jennings and Luc Moreau 13

Artificial Intelligence Group (AIG) at the University of York
Eduardo Alonso 14

Conference Reports

Trading Agents
Magnus Boman 15

ESAW'00 workshop on Engineering Societies in the Agents' World
Andrea Omicini, Robert Tolksdorf and Franco Zambonelli 17

AgentLink Reports

What's Happening in AgentLink?
Michael Luck 18

Report on European Agent Systems Summer School EASSS 2000
Matthias Klusch and Klaus Fischer 19

New Call for technology take-up project proposals for innovative users and suppliers of agent technologies or middleware for distributed applications
Max Lemke 21

Conference and Workshop Calendars 22

It is now almost five years since the main international agent standardisation effort FIPA (the Foundation for Intelligent Physical Agents) was founded. This issue of AgentLink News provides an update on the ongoing FIPA activities including overviews of the new structure of FIPA, recent advances, the current set of specifications, an overview of current open source implementations, and future activities.

E-Commerce is widely recognised as a promising application area for agent technology. Much effort up to now has been spent on applications that help businesses distribute their goods and services to consumers in a more intelligent way. In contrast, we present here a report from Lost Wax, a company which has been concentrating on the development of agent applications in transactions between businesses, known as B2B (business to business).

This issue is also filled with interesting conference, project, and site reports. For instance, you will find a report from the first concertation meeting of the EC-funded projects belonging to the Universal Information Ecosystem (UIE) initiative within the Future & Emerging Technologies Programme (FET). The UIE is a vision of a massive, scalable and flexible network that constantly scales up or down, evolves and adapts in order to meet the changing demands of its highly dynamic population, potentially consisting of millions of inter-operating autonomous *infohabitants*.

As usual we have included some administrative information concerning AgentLink as well as a report of the first main activity of AgentLink II, the highly successful second European Agent Systems Summer School that took place in Saarbrücken, Germany this summer.

Being the first issue coming through AgentLink II proper, we would like to take this opportunity to thank Mike Wooldridge for all his efforts on setting up AgentLink back in 1998. With the start of AgentLink II in August 2000, Mike stepped down as AgentLink Coordinator and handed over to Michael Luck of the University of Southampton.

Finally, remember that AgentLink is a network run by its members for the benefit of the community, on whom it relies for feedback. If you have any comments or suggestions on the way ahead, email coordinator@AgentLink.org.

Paul Davidsson, Editor
and
Michael Luck, AgentLink General Coordinator

Open Standards and Open Source for Agent-Based Systems

Bernard Burg[1], Jonathan Dale[2] and Steven Willmott[3]

[1]Centre de Recherche de Motorola Paris, France. burg@crm.mot.com

[2]Fujitsu Laboratories of America, Inc., Sunnyvale, California, USA. jdale@fla.fujitsu.com

[3]Ecolé Polytechnique Fédérale de Lausanne, Switzerland. steven.willmott@epfl.ch

The world is becoming more connected. Internet usage is growing explosively, mobile data services are reaching users worldwide and businesses are moving to the web to connect with the customers, suppliers and partners. Agent technology has the potential to play a key role in this "revolution" by automating processes, enriching system-system communication and bringing more intelligent service provision. To realise this potential, agents require standards; they need to communicate to discover their peers, to negotiate and to co-operate in an open environment where everybody can add their contribution when and how it is deemed appropriate.
This article provides an update on the ongoing FIPA Agent standardisation effort at a time when agent standards seem more relevant than ever. Briefly covered are the new structure of FIPA, recent advances, the current set of specifications, and an overview of current open source implementations and ongoing/future activities.

FIPA: Open Standards for Software Agents

The Foundation for Intelligent Physical Agents (FIPA) was formed in 1996 as a non-profit organisation with the remit of producing software standards for heterogeneous and interacting agents and agent-based systems across multiple vendors' platforms. This is expressed more formally in FIPA's official mission statement:
The promotion of technologies and interoperability specifications that facilitate the end-to-end interworking of intelligent agent systems in modern commercial and industrial settings.
The emphasis here is therefore on the practical commercial and industrial uses of agent systems. The aim is to bring together the latest advances in agent research with industry best practice in software, networks and business systems.
FIPA undertakes its work at meetings that are held four times a year and conducts its standardisation process in a collaborative and open manner as specifications are publicly accessible during their lifetime and participation at meetings is free of charge.

Structure of FIPA

FIPA is organised and structured according to two kinds of groups. The following are the *Administrative Groups*:

- The FIPA *Board of Directors* (BoD) is responsible for managing and conducting the business of the FIPA organisation.
- The FIPA *Architecture Board* (FAB) is the authority within FIPA that is responsible for ensuring the consistency, accuracy and suitability of FIPA's technical work.
- The FIPA *Secretariat's*, in charge of administration, logistics, membership and information dissemination of FIPA.
- The *Image Committee* is building some communication channels for FIPA and presentations of the standard inside and outside the agent community.

The other kind are *Technical Groups*. FIPA's core standardisation activities are centred around the creation and maintenance of specifications.

- *Technical Committees* (TCs) produce technical work and write the FIPA specifications. The life cycle of a TC starts with a work plan submitted to the FAB. If approved, the FAB proposes to create a TC, the BoD takes the decision and the TC is created with the mission to fulfil the work plan.
- *Working Groups* (WGs) are designed to carry out other aspects of FIPA's work, which are not necessarily defined by technology; they may have an application focus or be responsible for coordinating implementation activities. The lifecycle of a WG is similar to that of a TC.
- *Special Interest Groups* (SIGs) undertake auxiliary work which is of interest to sections of FIPA membership, such as liasing with other standards bodies and dealing with emerging technologies which might be suitable for standardisation.

Developments in FIPA

The year 2000 has seen intense activity within FIPA and great changes in the technological landscape which forms the backdrop for its activities. This has resulted in both technical advances and changes to FIPA's structure and specification process. The main procedural changes can be summarised as follows:

- A new, more open specification process based on a permanently open call for work plans from both members and non-members (See http://www.fipa.org/about/fab.html).
- A multi-track standardisation process decoupling standards to enable work in different areas to progress at different speeds.
- A multi-step document process reflecting the different levels of maturity of the specifications through successive grades of maturity: *Preliminary*, *Experimental*, *Standard* through *Deprecated* and *Obsolete*.

Technical work has also made significant progress:

- Development of a global Framework to link together the totality of FIPA specifications into a single Abstract Architecture.
- Integration of Web technologies into the standards including: HTTP message transport, XML encodings for FIPA ACL messages and an RDF content language.
- Modularisation of all specifications to create a "plug and play" architecture supporting interchangeable *component* specifications for areas such as content languages, performatives, protocols, message transport and language syntax complemented by *profiles* to link together sets of components.

FIPA Specifications

Since January 2000, FIPA has adopted a new procedure for classifying, organising and releasing specifications to ensure coherence,

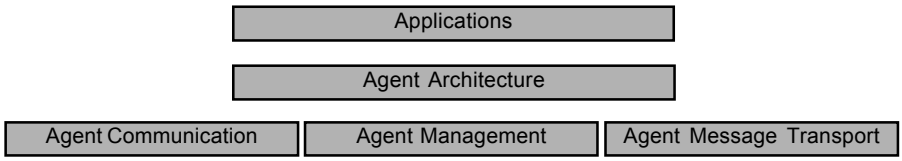

Figure 1: Specification Breakdown

completeness and consistency of its work as well as its relevance to industrial and commercial interests. This section provides an overview of the new specification structure and the current set of FIPA specifications.

FIPA specifications are divided into five categories: Applications, Abstract Architecture, Agent Communication, Agent Management and Agent Message Transport (see Figure 1). Each area of specifications has one or more specification documents assigned to it and involved one or more technical committees or working groups.

Abstract Architecture

The purpose of the FIPA Abstract Architecture (see [FIPA00001]) is to foster interoperability and reusability; this leads to the identification of architectural abstractions linked by their relationships. It makes a distinction between those elements which can easily be defined in an abstract manner, such as agent message transport, FIPA ACL, directory services and content languages, and between those elements that cannot, such as agent management and agent mobility. These are considered difficult to represent abstractly since they occur too close to the concrete realisation (implementation) of an agent system and very little commonality can be derived from analysing them. Yet, these issues will have to be addressed by developers and the abstract architecture will provide a number of instantiation guidelines in the future for specific groupings of implementation technologies.

The first concrete realization of the abstract architecture will be the Java Agent Service project which is being developed as part of the Java Community Process.

Agent Message Transport

The FIPA Agent Message Transport Specifications deal with the delivery and representation of messages across different network transport protocols, including wireline and wireless environments.

At the message transport level, a message consists of a message envelope and a message body. The envelope contains specific transport requirements and information that is used by the Message Transport Service (MTS) on each agent platform to route and handle messages. The message body is the payload and is usually expressed in FIPA ACL but is opaque to the MTS since it may be compressed or encoded.

The agent message transport reference model provides facilities for:

- General support for an MTS within an agent platform (see [FIPA00067]).
- Guidelines for using specific Message Transport Protocols (MTPs), such as IIOP (see [FIPA00075]), HTTP (see [FIPA00084]) and WAP (see [FIPA00076]).
- Message envelope representations that are suitable for each MTP, such as an XML encoding for HTTP (see [FIPA00085]) and a bit-efficient encoding for WAP (see [FIPA00088])[1].
- FIPA ACL representations, such as a string encoding (see [FIPA00070]), an XML encoding (see [FIPA00071]) and a bit-efficient encoding (see [FIPA00069]).

The MTS on each agent platform can support any number of message transport protocols and will normally translate between a FIPA-supported MTP that is used for interoperable communication between heterogeneous agent platforms (such as XML over HTTP) and an MTP that is used internally to the agent platform (such as Java objects over the Java Messaging Service). Consequently, the components of the MTS are designed to be modular and extensible to handle different message transport protocols, message envelope and FIPA ACL representations in the future.

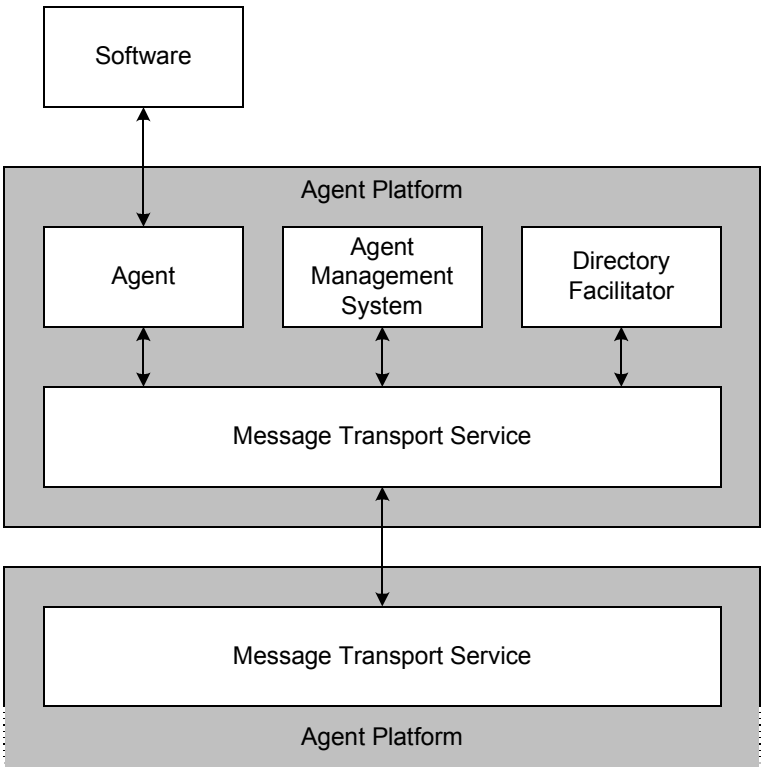

Figure 2: Agent Management Reference Model

Agent Management

The FIPA Agent Management Specification (see [FIPA00023]) provides the framework within which FIPA agents exist and operate. It establishes the logical reference model for the creation, registration, location, communication, migration and retirement of agents.

The reference model (see *Figure 2*) describes the primitives and ontologies necessary to support the following services in an agent platform:

- White pages, such as agent location, naming and control access services, which are provided by the Agent Management System (AMS). Agent names are represented by a flexible and extensible structure called an agent identifier, which can support social names, transport addresses, and name resolution services, amongst other things.

[1]The message envelope representation for IIOP is expressed in IDL and is specified in [FIPA00075].

Organisation	Platform Name
Comtec (Japan)	Comtec Agent Platform
CSELT (Italy)	Java Agent Development Framework (JADE)[2]
Fujitsu Laboratories of America (USA)	April Agent Platform[3] (AAP)
Nortel Networks (UK)	FIPA-OS[4]

Table 1: Available Open Source FIPA Agent Platform Implementations

- Yellow pages, such as service location and registration services, which are provided by the Directory Facilitator (DF).
- Agent message transport services as described previously.

In conjunction with the FIPA Agent Message Transport Specifications, the FIPA Agent Management Specification also provides support for intermittently connected devices, such as laptop computers and personal digital assistants through message buffering, redirection and proxying.

Agent Communication

Developers of multi-agent systems require specialised communication techniques in order to structure the interactions in their agent systems. Ad hoc techniques are usually not sufficiently well designed or documented to be consistently extensible and implementable by others, or generally applicable to a wide set of agent problems. The FIPA specifications for agent communication address these issues. The core of these specifications was largely completed in FIPA 97, but this specification set has required continual maintenance and development since then. The specifications of the communication language, along with libraries of predefined communicative act types, interaction protocols and content languages were developed:

- FIPA ACL Communicative Act Specifications is the library of all the 22 FIPA communicative acts and their requirements (see [FIPA00037])
- FIPA ACL Message Structure Specification describes the grammatical structure of the FIPA ACL (see [FIPA00061])
- FIPA Interaction Protocol Library Specification is the library of FIPA interaction protocols and requirements for new interaction protocols (see [FIPA00025]). Currently existing FIPA interaction protocols are:
  - FIPA Request Interaction Protocol Specification (see [FIPA00026])
  - FIPA Query Interaction Protocol Specification (see [FIPA00027])
  - FIPA Request When Interaction Protocol Specification (see [FIPA00028])
  - FIPA Contract Net Interaction Protocol Specification (see [FIPA00029])
  - FIPA Iterated Contract Net Interaction Protocol Specification (see [FIPA00030])
  - FIPA English Auction Interaction Protocol Specification (see [FIPA00031])
  - FIPA Dutch Auction Interaction Protocol Specification (see [FIPA00032])
  - FIPA Brokering Interaction Protocol Specification (see [FIPA00033])
  - FIPA Recruiting Interaction Protocol Specification (see [FIPA00034])
  - FIPA Subscribe Interaction Protocol Specification (see [FIPA00035])
  - FIPA Propose Interaction Protocol Specification (see [FIPA00036])
- FIPA Content Language Library is a generic description of the requirements for a FIPA content language. (see [FIPA00007]). The following content languages have been specified by FIPA:
  - FIPA SL Content Language Specification (see [FIPA00008])
  - FIPA CCL Content Language Specification (see [FIPA00009])
  - FIPA KIF Content Language Specification (see [FIPA00010])
  - FIPA RDF Content Language Specification (see [FIPA00011])

Agent Applications

FIPA has developed specifications of four agent-based applications that contain service and ontology descriptions and case scenarios:

- *Personal Travel Assistance:* individualised, automated access to travel services (see [FIPA00080]).
- *Audio-Visual Entertainment and Broadcasting:* negotiating, filtering, and retrieving audio-visual information, in particular for digital broadcasting networks (see [FIPA00081]).
- *Network Management and Provisioning:* automated provisioning of dynamic Virtual Private Network services where a user wants to set up a multi-media connection with several other users (see [FIPA00082]).
- *Personal Assistant:* management of a user's personal meeting schedule, in particular in determining time and place arrangements for meetings with several participants (see [FIPA00083]).

Additionally, the *Agent Software Integration* specification (see [FIPA00079]) contains guidelines for integrating legacy software; that is, software that does not communicate using FIPA ACL.

Current Implementation of FIPA Specifications

Sixteen FIPA platforms have been implemented by diverse companies, four of which are freely accessible under open source (see Table 1). These FIPA platforms have been distributed and tested in large-scale projects, which collectively have been downloaded several thousands of times.

In addition to a choice of FIPA platforms which are aimed at agent researchers with software development experience, there is also a need for agent development environments that cater for non-specialists. ZEUS is one such platform and it is based around a GUI that facilitates the rapid development of collaborative agent applications (see *Table 2*). The next generation of platforms is already under development: two ongoing European projects include work on enabling the FIPA platforms for wireless devices (CRUMPET [CRUMPET] and LEAP [LEAP]), and a Java Community Process (JAS) addressing Java Interfaces for agent services has recently started [JAS-2000]. These initiatives aim to deliver new implementations by the end of 2001.

Company	Platform Name
BT Laboratories (UK)	ZEUS Agent Building Toolkit[5]

Table 2: Available Open Source FIPA Agent Development Environments

[2] See http://sharon.cselt.it/projects/jade/

[3] See http://www.sourceforge.net/projects/networkagent/

[4] See http://fipa-os.sourceforge.net/

[5] See http://www.labs.bt.com/projects/agents.htm

Current and Future Work

Current Standardisation Activities

FIPA TCs and WGs are currently working on a number of areas that are being specified for standardisation:

- *Domains and Policies TC*

  The general focus of this TC is the application and management of policies and constraints on agents and collections of agents to control their behaviour. This requires providing mechanisms for describing what policies can be applied to which agents and in what environments; for example, what controls are available and how to report inability or conflict when applying policies. The range of possible mechanisms for enforcing policies can extend from reputation and social sanctions to complete withdrawal of supporting services for a non-conforming agent.

- *Agreements Management TC*

  The Agreements Management TC is concerned with providing support to allow agent platforms to manage and maintain large constellations of agent platforms and agents, to define configurations and dependency links between these entities and to provide management and configuration methods for controlling federated agent platforms and communities of agents. As part of this work, it is necessary to consider agreements, or contracts, between agents and to specify the services within those agreements. An agreement to provide a service of some kind is the goal of a process of negotiation between agents and the basis for their collaborative activity.

- *Gateways TC*

  The aim of this TC is to enhance the nomadic application environment and its objective is to look at the interoperability of the existing FIPA message transport services by using different transport protocols and message encoding, and to support messaging in the environment of nomadic applications. This requires investigating issues such as support for disconnected modes of operation, roaming from one mediator to another one, profiles that specify capabilities of gateways and mobile terminals, and a bit-efficient representation of information, including the message envelope and the content of the ACL message.

- *Product Design and Manufacturing WG*

  The objective of this WG is to promote and support the development of agent applications within the manufacturing domain, such as workflow management, enterprise integration, supply chain management, information management, scheduling, e-commerce and control of transportation.

- *AgentCities WG*

  The AgentCities WG aims to encourage and support the development of a continually available, publicly accessible network of deployed FIPA agent services. This network is to serve as an experimental test bed for interoperability testing, application development and as a showcase for FIPA technology. An *AgentCity* is a metaphor for a virtual set of agents and services that represent a real place or city and as the network of cities grows, there are rich potential interactions between many different agents and consequently the possibility of complex business models emerging.

Future Areas of Activity

Some FIPA SIGs are currently considering other technologies for standardisation:

- *Ontology SIG*

  Investigating the nature and realisation of ontologies and ontology descriptions within FIPA specifications.

- *Security SIG*

  Investigating the security related issues within FIPA architectures and formulating a long term strategy for the integration of security features into FIPA specifications.

- *Peer-to-Peer SIG*

  Investigating the links between FIPA technology and new paradigms for system-system interaction. In particular coordinating with related peer-to-peer efforts such as Intel's peer-to-peer forum.

Conclusions

FIPA has devoted its first years to specify the basics elements of an agent-based world, defining the communication language, the management and the connection to existing software. This initial specification has been implemented by several teams and showed the way for further improvement towards a more modular agent environment capable of evolution and integration of new technologies, e.g. using several Message Transport Layers, and moving towards higher levels of abstraction. Four of these new implementations are already accessible in open source, and new FIPA implementations now enable agents to run on small wireless devices such as PDAs. As such FIPA is making an important contribution to the practical and commercial viability of agent systems by providing a good basis to develop future agent-based applications.

FIPA is now looking ahead to some of the major challenges that are already beginning to arise in the new "networked" world, and works on specifications for:

- Domains, policies, agreements and contracts, security, dependencies between large numbers of agents, and agent usage of ontology.
- Key applications such as product manufacturing and design and peer-to-peer systems.
- Large-scale deployment of agent systems in open environments.

Acknowledgements

The authors would like to express their thanks to all of the people and organisations (both past and present) who have contributed to the FIPA standardisation process.

References

CRUMPET: "The Creation of User-friendly Mobile services Personalised for Tourism", IST-2000—— (Number unknown/unassigned).

FACTS: "FIPA Agent Communication Technologies and Services", Project Number ACTS-1997-AC317.

LEAP: "Lightweight Extensible Agent Platform", Project Number IST-1999-10211, http://www.cordis.lu/ist/projects/99-10211.htm, and http://leap.crm-paris.com/

[JAS-2000] JAS Java Agent Services Initiative, http://java.sun.com/aboutJava/communityprocess/jsr/jsr_087_jas.html, October 2000.

[GRID] "The DARPA Grid Architecture" http://coabs.globalinfotek.com, see also http://fipa.umbc.edu/18/kahn.pdf.

[peer-to-peer-forum] http://www.intel.com/pressroom/archive/releases/cn082400.htm

The role of agents in business to business (B2B) electronic commerce

Steve Osborn

Senior software developer, Lost Wax, RIchmond, Surrey, UK

Steve.Osborn@LostWax.com

Lost Wax is one of Europe's most innovative software development companies, whose proprietary agent-based software solutions for intelligent e-commerce are at the forefront of online trading. Lost Wax's customers include The Baltic Exchange, Egg, Eurobenefits, General Motors On:Line Finance, Moneyextra, Lastminute.com, Sony, Psion and Orange.
Lost Wax delivers an internet-based Application Service Provider (ASP) solution which is based upon its B2B e-Commerce Platform and has a well established and experienced e-Services division which develops bespoke, business critical, e-commerce solutions.
www.lostwax.com

Growth of B2B e-Commerce

In Issue 5 of Agentlink News, Kees Jonkheer from NetlinQ discussed the potential applications for intelligent agents in an Online Distribution Structure which helps businesses distribute their goods and services to consumers in a more intelligent way. Here at Lost Wax, we have been concentrating on the development of agent applications in another area of e-Commerce – the varied world of transactions between businesses, now known as B2B (business to business). The B2B e-Commerce world continues to grow rapidly and those people tackling the issues now and preparing for the future will undoubtedly benefit from their head-start.
e-Commerce is entering its third phase of development. First came information-only web sites – on-line brochures that allowed buyers to access and view what a company had to sell. These were followed by solutions that supported fixed-price buying and selling over the internet - mirroring the process of buying from a shop. These simple transactional systems were the engine that drove Business to Consumer (B2C) web sites.
The third phase supports new forms of online buying and selling that involves negotiation between multiple parties across multiple parameters – auctions, aggregation of supply & demand and automated negotiation. This is already the norm for trading between many existing businesses, and developments in technology make it possible to effectively automate and augment this process. We believe that this requires an Agent based software development approach to be implemented effectively.

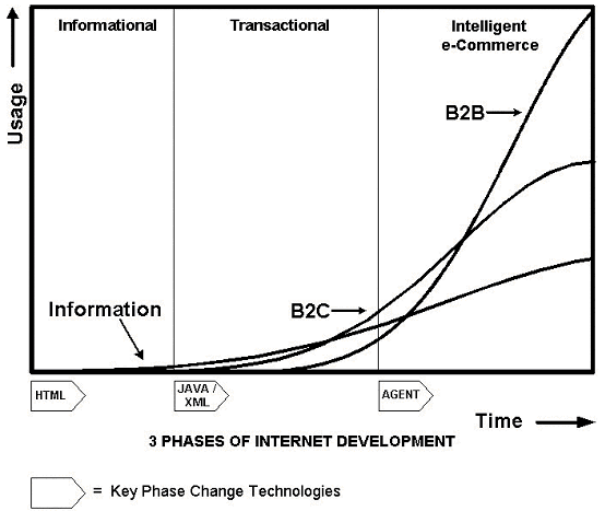

Figure 1: The evolution of e-commerce

B2B culture

For thousands of years, commercial winners have been excellent negotiators. The quickest and the best negotiators have tended to build the biggest and the best businesses. However, even the very best humans have a finite skill set, bandwidth, location and attention span. Intelligent agents are able to complement this skill set by providing the capability to either trade and negotiate on our behalf or alert us to the opportunities in what is an increasingly busy and complex commercial environment.
In this environment, buyers and sellers tend to have more of an understanding of the dynamics of the markets they are operating in and product and service descriptions are more deeply understood. These factors mean that agents, especially negotiation and auction agents fit very well into the B2B world.

Accepting and trusting Agents – a migration path

Some people maintain that the acceptance of agent systems in the B2B world seems to hinge around an issue of trust and accountability. However, this might only become an issue when agents are working in a fully autonomous mode and this may be some time off in the commercial world. What we will see before then is a migration path from simple agents to more complex ones.
Today, we are seeing the following simple applications of agents:

- Monitor agents – keeping a watching brief and alerting the owner
- Negotiation agents – making and responding to offers
- Auction agents – bidding in online auctions

In all these cases, the software is capable of making decisions without constantly referring back to the user and responds appropriately to the prevailing circumstances at the time and adapts its decisions to dynamic and unpredictable situations.

To people currently outside the agent world, we expect these simple applications of agents to be regarded as very useful tools (in some cases with human-like characteristics/personalities), rather than replacements for human decision-making. For the foreseeable future, the ultimate decision-maker is likely to remain one of flesh and blood, and by delegating to software the degree of trust will increase.

Lost Wax has done a fair amount of research into the roles of Multi-Agent systems and their application in areas within B2B and telecoms industries, but for the purpose of this article we shall concentrate on the use of individual intelligent agents in B2B applications.

One example of the implementation of Lost Wax's proprietary Agent Technology is in our B2B e-Commerce Platform – e-Market. Building this, our development team has worked in close conjunction with Professor Nick Jennings of Southampton University and the individual technologies employed in e-Market are currently being patented in the US, whilst the platform is being used by electronic marketplace owners across Europe.

Designing negotiation agents

One of the first design objectives for the product was the provision of an architecture that allowed for a practical and comprehensible method of automating negotiation and other types of transactions between e-market participants. The negotiation agent implementation strategy is portable across different market types and customised to fit the individual characteristics of each market. The software components can be employed independently of one another.

In order for negotiation to be possible, there has to be a common language which covers the variables – e.g. price, condition, colour, delivery date, delivery location, payment method, size, texture, presentation, packaging or country of origin.

This language must capture the parameters for the negotiation, and the manner in which the negotiation is to be conducted between the participants.

The Lost Wax B2B e-Commerce Platform system provides for a common language in its business *ontology*. This describes all the features and aspects of products, requirements and users in a given market. It also allows the definition of relationships between these terms, e.g. the ability to model constructs such as hierarchy and aggregation.

The system also provides a negotiation protocol to describe an interaction. The negotiation protocol ensures agents understand the courses of action open to them and that their understanding matches that of their owners. For example, these can be actions such as accepting offers, making bids, entering into conversations, breaking off communication etc.

The protocol is implemented as a state transition graph denoting the alternative responses at each stage of the discussion. This protocol can be configured for each e-market and for different types of transaction (see an example below – Figure 2). It also allows for configuration of such state dependent elements such as anonymity and whether the party would be committed to any offers they make.

Buyer-driven or seller-centric?

The Lost Wax B2B e-Commerce Platform architecture was designed to allow the easy integration of agents acting for either the buyer or the seller. Within an electronic market, human sellers can interact with buyer agents or vice versa – alternatively both sides can be agents. If desired, the agents can exhibit a wide range of autonomy, from constantly monitoring the market to searching for a particular good through to complete automation of the buying or selling process on behalf of their owner e.g. in an auction. Also, the autonomy of the agents can be limited so, for example, any final deal decision must be referred to the agent owner.

As mentioned above, trust, accountability and consistency are very important in any implementation of this technology. The seller and buyer have to understand the modus operandi of the agent clearly and believe it will act in the best way to sell or buy on their behalf. There must be a clear audit trail that allows an understanding of how a decision is reached.

When a buyer or seller allocates an agent to their product or buying requirement, they need to specify the price value of all the terms that they are prepared to negotiate on. Then when the agent receives an offer from another participant, it can evaluate the acceptability of the offer and compare this against a target "acceptable offer". This target "acceptable offer" can be calculated to reflect many different parameters such as the current market state or how long the product has been on the market. The agent will only accept the offer if the value exceeds the target. Otherwise it will either decline or make a counter offer (depending on how acceptable an offer it was and whether the offer represented a move forward from previous offers). The counter offer is constructed using the agent's knowledge of the values of all the parameters it negotiates on and the model it builds up over time of the values that the other party places on the negotiable parameters.

Because of the way the strategy is implemented, negotiation will either converge to

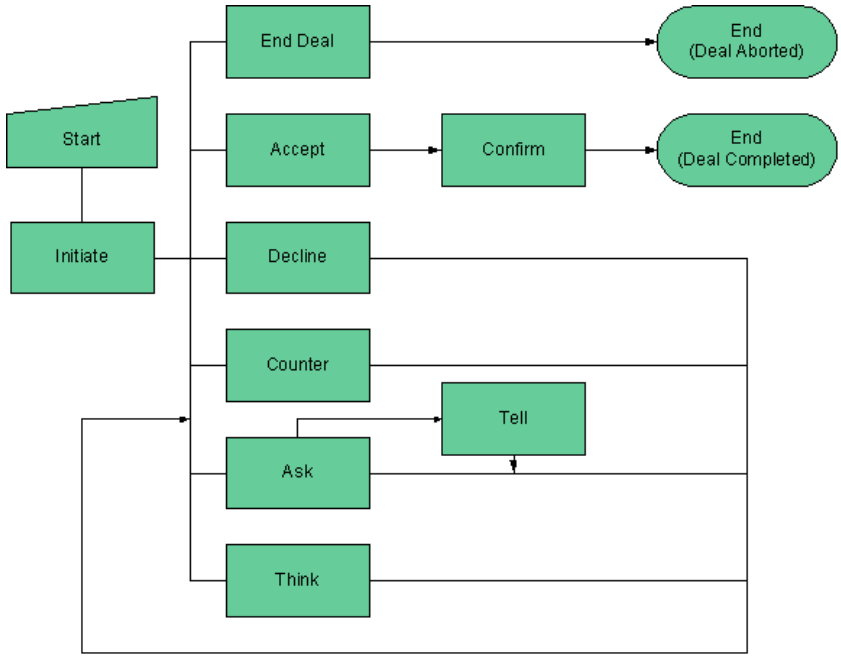

Figure 2: An Agent negotiation process

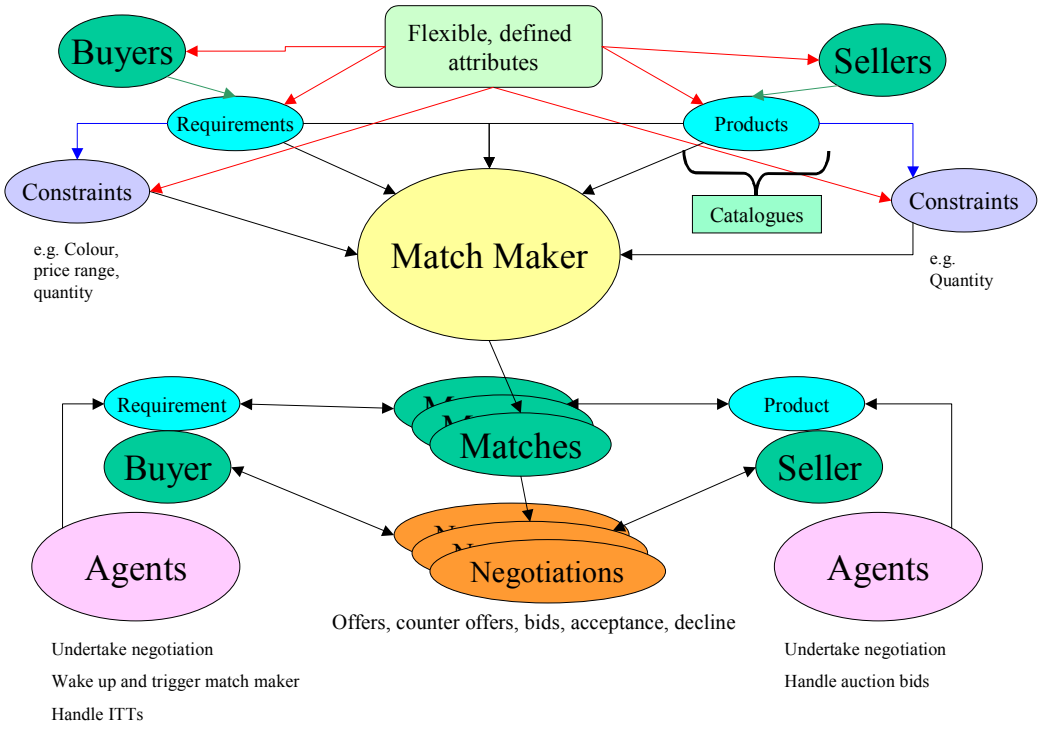

Figure 3: e-Market architecture

an offer that is mutually acceptable to both sides or will reach an impasse, in which case there can be no way of agreeing to a deal.

The Lost Wax platform

The agents in Lost Wax's e-Market system are effectively Enterprise Java Bean objects that implement either of the e-Market buyer agent or seller agent interfaces. The agents are linked to respective product offerings or buyer requirements (see Figure 3). This provides both flexibility and scalability. Flexibility is provided as new market specific agents can be written and easily integrated into the platform. The e-Market architecture allows for agents to be distributed over multiple servers and provide scalability to the system, which can become critical when there become many thousands of such agents, each actively polling the market and conversing with each other.

An e-Market agent has to be written to operate in two ways, reactively and proactively. Agents behave reactively when they are asked to respond to a conversation element passed to it by a potentially interested buyer/seller. The agents however are also proactive by choosing when to actively search the market and initiate deals with other parties, and when to ask the e-Market scheduler to wake them up at a predetermined time, e.g. two hours before the close date of an auction they wish to bid on.

Some of the more complex negotiation agents are required to adopt a more strategic view of how they interact in the market. For example, a buyer agent may be required to satisfy a user's buying requirement before a deadline. Within this time frame it has to actively poll the market and decide which product it is going to make offers, negotiate or bid on. Any strategy that it formulates has to be refined and updated as new products come into the market. A derivation of the standard agent Belief Desire Intention (BDI) architecture is used to construct plans and then re-evaluate them at regular intervals.

Conference – The Next Generation of e-Commerce: Agent Technology

Whilst we've all still got a lot to do to resolve some of the issues mentioned above and the marketeers have their work cut out to increase the awareness of Agents, we expect to see a surge in the commercial application of Agent Technology in 2001.

Agents may well be use first for automating simple tasks, such as providing information, monitoring and match-making, but as they become more trusted, more intelligent and more socially aware, they will be used more and more.

Lost Wax is kicking off the year with a major conference exploring the role of Agent Technology in the next generation of e-commerce. This takes place in London on 30 January 2001 and will involve speakers from leading companies in the e-commerce and agent technology world. We'd be delighted to see members of AgentLink attend this event – to register, please visit LostWax.com or email thinkagent@lostwax.com

Let A Million Agents Bloom: Infohabitants and Universal Information EcoSystems –

FET UIE Concertation Meeting, Imperial College, December 1st 2000

Jeremy Pitt

Imperial College of Science, Technology & Medicine, London, UK

j.pitt@ic.ac.uk

The European Union Future & Emerging Technologies Programme (FET) has a vision of the Universal Information Ecosystem (UIE): a massive, scalable, flexible network that constantly scales up or down, evolves and adapts in order to best meet the changing demands of its vast and highly dynamic population. The population consists of millions (possibly trillions) of interoperating, heterogeneous autonomous *infohabitants*, each individually aware of the opportunities available to them, capable of autonomous decision making to take advantage of them, and cooperating to meet transient needs and conditions.

After the first call for Proposals (1999), six projects were funded to try to realise this vision. The projects are:

- ALFEBIITE: A Logical Framework for Ethical Behaviour between Infohabitants in the Information Trading Economy of the Universal Information Ecosystem
- DIET: Decentralised Information Ecosystem Technologies
- DREAM: Distributed Resource Evolutionary Algorithm Machine
- EEII: Evolution and Ecology of Interacting Infohabitants
- ICITIES: Information Cities
- SLIE: Sustainable Lifecycles in Information Ecosystems

The first Concertation Meeting (an open meeting between all projects) was held on December 1st 2000, at the Department of Electrical and Electronic Engineering, at Imperial College, London. Thirty-five people from the projects attended, as well as interested third parties, and representatives of the EU and AgentLink II.

The Meeting consisted of a presentation of each project's aims and objectives, and preliminary results. An 'Open Forum' slot enabled interested researchers to present related material, which included the EasyComp project and a presentation from the University of Girona. The meeting ended with an open discussion on the main issues.

The ALFEBIITE project is undertaking an inter-disciplinary investigation into normative behaviour between infohabitants in the 'infoworld' that represent people or organisations in the real world. Its first technical deliverable has just been completed, comprising a collection of 15 technical papers, and key interim results were reported. These focussed on the formal analysis (from philosophical and psychological perspectives) and operationalisation of trust, formal models of agent societies and communication, and prototype simulators.

DIET is constructing a flexible and scalable software architecture inspired by natural ecosystems, for use in information management, and intends to apply this to four validation tasks: information retrieval (data mining), information alert (context-sensitive push), information trading and trend analysis. An initial prototype has been developed.

In the DREAM project a virtual machine is being constructed, using a number of simple machines connected over the Internet. This allows infohabitants to evolve, communicate, negotiate and trade, in the pursuit of some individual goal, with the possible achievement of some global goal. The DREAM project aims to deliver a general framework which will allow the easy development of DREAMs and the experiments that run on them. These experiments include optimisation (scheduling), modelling (data mining), and simulation (of simplified aspects of society and human behaviour).

The EEII project is studying a population of infohabitants, with a carefully designed interaction over a well-defined ontology. Soft computing is used as a model for interaction and the study of properties such as scalability, openness, adaptability, and stability. The aim is to derive concrete and demonstrable results that can be used in the design of universal information ecosystems.

ICITIES is exploring and validating models for the creation and formation of Information Cities over the emerging Information Infrastructure by using analogies and patterns of aggregation/segregation of inhabitants in current Physical Cities, Business Districts and Urban Communities. It is creating new formal models (e.g. behavioral models for infohabitants) to study the formation of Information Cities, investigating the fundamental forces and dynamics for the stability and evolution of Information Cities, and developing an open simulation and emulation environment to study emerging behaviours and structures, and their evolution in time and space.

The SLIE project presented its work on developing models and methods of analysis for large agent-based systems. Some simulated behaviours were shown highlighting the need for design synthesis from specifications and understanding the global behaviour of an entire system from the behaviour of its individually designed components. Application case studies are planned on how to design to accommodate the environment in which a multi-agent system will be embedded, and connecting formal models and their behaviours.

The meeting was also addressed by Dr Loretta Anania, of the European Commission, and Project Officer for some of the UIE projects. While she welcomed the range of inter-disciplinary activities currently under investigation, and the community that was beginning to emerge in this collection of projects, she also highlighted a number of gaps (in the UIE and the related Disappearing Computers programme) that the managers had identified and sought to fill. Furthermore, the Commission was receptive to new ideas in emerging technology. She encouraged researchers to check the EC web-sites for information, and put together consortia to explore these ideas. There is clearly an opportunity for autonomous agents and multi-agent system researchers to secure European funding for good innovative ideas.

The meeting concluded with an open discussion of these and other issues. While there remained a significant number of challenges ahead (as identified even in the original call), the potential impact and technological delivery of the programme was very strong. The

emphasis on tools in the projects suggested that powerful agent-based simulation and modeling tools will be produced, as well as environments for reliable, secure lightweight mobile agents and reflexive, dynamic architectures for individual infohabitants. The impact on engineering design (analysis and prediction), on system development and deployment, and on the user-friendly information society (trust in and of e-commerce), is considerable. A number of significant new opportunities were identified, including DARPA initiatives (GRID and DAML), and the new peer-to-peer working group.

Ultimately, this was an enjoyable and successful meeting, which provided a focus and forum for partners in UIE projects, related projects and interested third parties to get together. It was certainly useful in encouraging cross-project linkages, and possible knowledge/technology transfer, disseminating research areas and breaking results to the wider community; and in identifying important areas for investigation, trends and issues.

Copies of the Proceedings (slide-packs of presentations) can be requested from the organisers (Jeremy Pitt (j.pitt@ic.ac.uk)). Otherwise, for more information, the following URLs are to be noted:

- Future and Emerging Technologies – http://www.cordis.lu/ist/fethome.htm
- Universal Information EcoSystems – http://www.cordis.lu/ist/fetuie.htm
- ALFEBIITE – http://www.alfebiite.com/
- DIET – http://www.labs.bt.com/people/marrowp/index.htm
- DREAM – http://www.world-wide-dream.org/
- EEII – http://www.ee.ic.ac.uk/research/neural/eeii.html
- ICITIES – http://icities.csd.voc.gr
- SLIE – http://www.dai.ed.ac.uk/groups/ssp/slie/
- EASYCOMP – http://www.easycomp.org/

Project Report

An Overview of the SSAHLA Project – Simulation based on Software Agents and the High Level Architecture

Zakaria Maamar

College of Information Systems, Zayed University, Dubai, United Arab Emirates & Computer Science Department and Research Center in Geomatics, Laval University, Ste-Foy, Canada

zakaria.maamar@zu.ac.ae

Training is a key factor to the development and enhancement of military forces' background and to the success of the operations these forces undertake. Training aims at stating to the participants, among them commanders, operators, how they should behave and react in front of real situations. However, deploying military forces for training needs is complex and costly. It involves diverse partners and requires preparation and resources. Therefore, it becomes urgent to suggest facilities that could support training. Among these facilities, digitalizing battlefields seems to be relevant. Training will consist of simulating the operations to be carried out. Simulation has several advantages: reducing costs, recording missions for learning purposes, and allowing participants to rehearsal their missions.

There exist several research projects in simulation, particularly in the military domain [1]. Most of these projects aim at connecting military systems, called Command & Control Information Systems (C2ISs), to simulation applications. The High Level Architecture (HLA) is the middleware that is widely used between these C2ISs and these applications. At Zayed University, we intend on leveraging this connection by designing a collaborative environment on top of the different simulation applications. Simulation based on Software Agents and the High Level Architecture (SSAHLA) denotes this environment. How to design this environment constitutes our main concern.

With digitalization facilities, simulation allows a participant to partake in military operations, without being in the battlefield. In order to meet the readiness requirement, this participant should be aware of the events that occur in his battlefield as well as in other battlefields. In addition, due to the development of information technologies a participant is able to receive multiple types of information from several sources, radars, and Web reports. We are convinced that our participant would be rapidly overwhelmed with a huge quantity of information and events that need to be dealt with in a short period of time. To assist such participants, we suggest associating them with software agents [2]. Thus, the digitalized battlefield would consist of agents, identifying for example the friendly troops, the enemy troops, the information sources, etc. Agents would be running on top of this battlefield.

Presentation of the SSAHLA Environment

In this section, we describe the architecture and functioning of the SSAHLA environment. The concepts that SSAHLA integrates are, also, discussed.

Architecture

Figure 1 presents the general architecture of the SSAHLA environment. Each participant is associated with a set of software agents that perform his operations. In fact, these agents constitute the simulated theatre. Currently, we are considering event-agents and participant-agents. Event-agents handle the

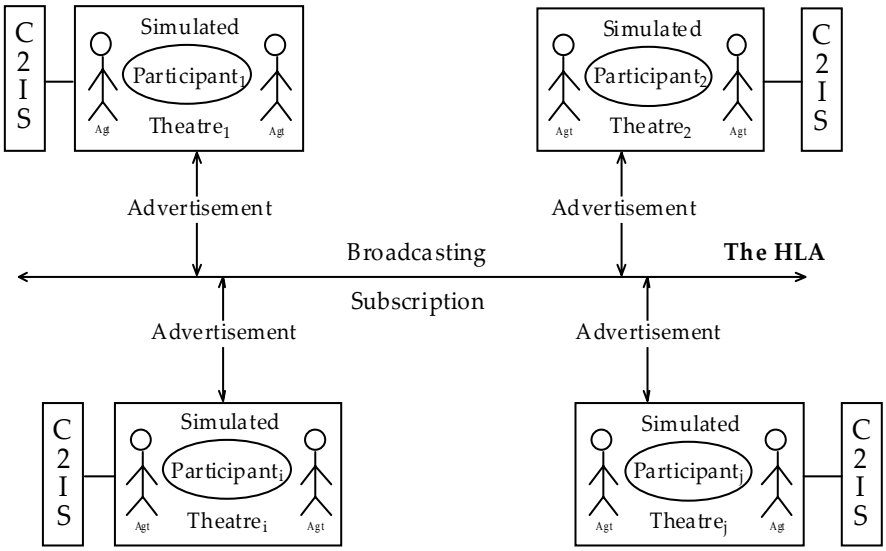

Figure 1: Architecture of the SSAHLA environment

events that occur in a theatre. At the same time, they monitor the C2IS's behaviour in term of updates. Such updates are associated with events. Events and their outcomes could be advertised to the participants of other theatres. These participants have expressed their interests, through subscription mechanisms. The HLA is in charge of managing broadcasting and subscripting.

- *What is a simulated theatre?* It is a digitalization of a participant's battlefield. A theatre is decomposed into several regions[1] . Agents populate regions and specific symbols are used to represent them in theatres. In addition, each theatre has a topographic representation, illustrating for example rivers, hills, and buildings. According to the HLA, theatres should have their Federation Object Models (FOMs) that rely on the information the C2ISs provide.
- *What is an event-agent?* It monitors the updates at the C2IS level. Each time there is an update, e.g. troops movement; it is, firstly, materialised at the simulated theatre level. An event-agent is in charge of this operation. Secondly, this event-agent associates this update with an event. The final step consists of triggering the Condition-Action template of this event. In case conditions are valid, participant-agents undertake actions. Event-agents could expect outcomes from participant-agents. Outcomes, viewed as events, could be broadcasted to the event-agents of other simulated theatres.
- *What is a participant-agent?* It implements the actions that correspond to the detected events. It may occur that several participant-agents are gathered together, in order to deal with an event. In that case, the event-agent designates a supervisor participant-agent that will be in charge of coordinating the operations of its group of participant-agents. Actions could consist of attacking enemy troops, moving a camp to another position, updating the content of a C2IS, etc. As mentioned in the event-agent's description, actions' outcomes of a simulated theatre could have consequences on other simulated theatres. Therefore, they are forwarded to event-agents of these theatres through the HLA.

Functioning

The functioning of the SSAHLA environment consists of five (5) steps. Events are the backbone of this functioning. Indeed, events result from agents needing to act and react, based on the knowledge they possess and the progress of ongoing operations. In what follows, the five steps are described:

- Step 1: this consists of setting up the simulated theatres and their agents. Event-agents will be mandated to monitor the C2ISs. For participant-agents, they will interact with participants in order to identify and interests. These interests will be transmitted to other theatres, through the HLA.
- Step 2: the HLA launches an exchange process of interests between the participant-agents of the theatres. Thus, each participant-agent would be alerted to its interests as well as to the interests of other participant-agents. Thus, this exchange allows the HLA to be aware of who is interested in what for broadcasting purposes.
- Step 3: as soon as an event-agent detects a modification in the C2IS's behaviour, it is associated with an event. The next step is to identify the Condition-Action template of this event in order to be triggered. If conditions are valid, the event-agent sets up a group of participant-agents. Among them, a supervisor participant-agent is designated. When carrying out actions, participant-agents are in constant interaction. Indeed, an action performed by a participant-agent could have an effect on another one.
- Step 4: after forwarding the events to the participant-agent supervisor who puts together its group of participant-agents, actions are executed. Among these actions, submitting an event to other theatres through the HLA. Actions influence theatres' shapes; for example a combat unit moves from one position to another one.
- Step 5: as soon as the actions are done, the participant-agent's supervisor broadcasts their outcomes to the participant-agents of other theatres that have expressed their interests, using the HLA. Based on the outcomes they receive, the participant-agents begin acting.

Summary

In this report, we briefly presented the SSAHLA project that aims at offering a train-

[1] *Two types of regions exist: intervention and influence.*

ing environment based on simulation. Two technologies are mainly used: software agents and the HLA. Currently, we are looking for partners who might be interested in collaboration.

References

[1] Simulation Interoperability Workshops. http://www.sisostds.org, 1999, 2000.

[2] N. Jennings, K. Sycara, and M. Wooldridge. A roadmap of agent research and development. *Autonomous Agents and Multi-Agent Systems*, 1(1) pp. 7-38, 1998.

Project Report

Agent-Based Social Simulation with JAM

Alexander Staller and Paolo Petta

Austrian Research Institute for Artificial Intelligence, Vienna, Austria

{alexs,paolo}@ai.univie.ac.at

In issue 5 of AgentLink News the BDI-theoretic JAM architecture was presented [4]. We briefly report on the utilisation of JAM in the course of a social simulation project at the Austrian Research Institute for Artificial Intelligence (http://www.ai.univie.ac.at/oefai/agents).

The Interrelationship between Social Norms and Emotions

It is now generally recognised that emotions play an important functional role within both individuals and societies, thereby forming an important bond between these two levels of analysis. In particular, there is a bi-directional interrelationship between social norms and emotions. On the one hand, emotions such as shame or guilt play an instrumental role for the sustenance of social norms. On the other hand, social norms are an essential element of regulation in the individual emotional system. Our project aims at studying this interrelationship, which has so far not been appreciated in research on multi-agent systems and social simulation.

The TABASCO$_{JAM}$ Architecture

For studying the interrelationship between social norms and emotions, an agent architecture modelling the emotion process at the micro (i.e. individual) level must be developed. Our goal is the development of TABASCO (a Tractable Appraisal-Based Architecture for Situated Cognizers), an architecture for agents situated in virtual environments. TABASCO is aimed at capturing the main components of the emotion process, which is seen as a crucial adaptive element of the agent-environment interaction. The theoretical foundation of TABASCO is the "appraisal theory of emotions" [5], postulating that emotions are elicited on the basis of a person's subjective *appraisal* of the personal significance of an event on a number of criteria, e.g., the importance of the event for one's goals and the potential to cope with the event. In trying to flesh out TABASCO, we build on established agent architectures for situated agents. JAM is a BDI-theoretic agent architecture that draws upon the theories and ideas of the Procedural Reasoning System (PRS) [2], a well-established approach towards integrating goal-directed reasoning and reactive behaviour.

TABASCO$_{JAM}$ models the main components of the emotion process on top of JAM. A first implementation of TABASCO$_{JAM}$ was evaluated in a social simulation. The scenario of the simulation was adopted from a well-known study by Conte and Castelfranchi [1], investigating aggression control as a function of a norm. In the original study, agents either rigidly violated or obeyed the norm. In our study, the simulation results reported in the original study were successfully reproduced, and consistent performances were achieved for extended scenarios with conditional norm obeyance. A detailed description of TABASCO$_{JAM}$ and the social simulation can be found at http://www.ai.univie.ac.at/~alexs/jasss_staller_petta.html (submitted for publication in "Starting from Society - the application of social analogies to computational systems", a special issue of the Journal of Artificial Societies and Social Simulation (JASSS), co-edited by Bruce Edmonds and Kerstin Dautenhahn).

Practical Experiences with JAM

The practical experiences we have made with JAM so far are positive. The manual [3] is very detailed and allows a straightforward specification of the JAM components. JAM functionality can be easily extended by writing appropriate Java classes. An API facilitates the usage of JAM classes. An aspect that could be improved is the support of debugging. It is possible to print information about the states of JAM components during run-time, but this information is a copious amount of text. Detecting the relevant details takes a while, at least for the unskilled JAM user. Perhaps a graphical user interface with a depiction of the JAM components and their interdependencies would further facilitate the development of JAM applications.

Conclusion

JAM looks very promising. We intend to use further developments of TABASCO$_{JAM}$ in increasingly complex scenarios, not only for social simulations, but also for the control of a synthetic character interacting with users in a 3D virtual environment.

References

[1] R. Conte and C. Castelfranchi. Understanding the Functions of Norms in Social Groups through Simulation. In G.N. Gilbert and R. Conte (eds.), *Artificial Societies: The Computer Simulation of Social Life*, UCL Press, London, pp. 252-267, 1995.

[2] M.P. Georgeff and A.L. Lansky. Reactive Reasoning and Planning. In *Proceedings of the Sixth National Conference on Artificial Intelligence*, Seattle, WA, pp. 677-682, 1987.

[3] M.J. Huber. *JAM Agents in a Nutshell - Version 0.61+0.79i*. Intelligent Reasoning Systems, Oceanside, CA, http://members.home.net/marcush/IRS/Jam/Jam-man.html, 1999

[4] M.J. Huber. JAM: A BDI-theoretic Mobile Agent Architecture. In *AgentLink News*, 5, pp. 3-6, 2000.

[5] K.R. Scherer. Appraisal Theory. In T. Dalgleish and M. Power (eds.), *Handbook of Cognition and Emotion*, Wiley, Chichester, pp. 637-663, 1999.

The Intelligence, Agents and Multimedia Group at the University of Southampton

Michael Luck[1], Nick Jennings[2] and Luc Moreau[3]

Department of Electronics and Computer Science, University of Southampton, UK

[1]mml@ecs.soton.ac.uk, [2]nrj@ecs.soton.ac.uk, [3]lavm@ecs.soton.ac.uk

The Intelligence, Agents and Multimedia Group in the Department of Electronics and Computer Science at the University of Southampton is one of the largest of its kind in the world. Reorganised and renamed in 2000 in the light of several new appointments in the areas of agent-based computing and artificial intelligence, to complement the existing activities in agent-based information management, the group now comprises over 60 members, with the agent research effort primarily being led by Michael Luck, Nick Jennings, Luc Moreau, Nigel Shadbolt and Dave de Roure.

The interests of the group span the complete range of agent research, including both work on the theoretical and conceptual foundations of multi-agents systems, as well as work on the issues surrounding the practical development and deployment of such systems. The former of these is witnessed, for example, in the use of explicit models of joint intentions, the development of novel algorithms for automated negotiation, and the study of inter-agent social and organisation relationships, while the latter is demonstrated by the numerous applications developed in many domains, including genome analysis, mobile telecommunications, e-commerce, workflow management, and distributed information management. Additionally, the Group has also concerned itself with the development of supporting infrastructure for multi-agent systems in its SoFAR and Paradigma frameworks.

Research funding has been received by members of the group from a range of organisations, including BT, HP, DERA, Marconi Communications, as well as national (BBSRC, EPSRC, ESRC) and European funding bodies. There are numerous relevant projects in which group members are involved, including the following.

ANNA: Acquisition for Networks of Negotiating Agents

This research is investigating and developing techniques by which software agents can acquire sufficient knowledge to negotiate effectively on behalf of their user in a range of electronic commerce scenarios. The research is exploiting and extending work in the Knowledge Acquisition community in order to determine exactly what knowledge an agent needs to be endowed with to negotiate on behalf of its user, what techniques are appropriate for capturing this knowledge, and how the agent's performance can be evaluated against its users' expectations. Funded by Hewlett Packard Research Labs.

GeneWeaver: agent-based genome analysis

As genome projects produce increasingly large quantities of sequence data, fast and reliable sequence analysis methods are required. Basic methods for comparing pairs of sequences or detecting patterns are well-developed, and now the key problem in analysing this genomic data is how to integrate the software and primary databases in a flexible and robust way. The agent paradigm lends itself very well to the problems of effectively managing and improving the processes involved in genome analysis and protein structure prediction. This project aims to develop a multi-agent system for exactly this task.

Magnitude: Mobile Agents Negotiating for Itinerant Users in the Distributed Enterprise

This project is designing and building the infrastructure that makes customised information available to intermittently connected users. For that purpose, we are investigating the use of mobile agents as autonomous intermediaries between nomadic users and fixed infrastructure services.

Application specific mobile agents, spawned from users' PDAs, will migrate to the infrastructure in order to autonomously undertake their task. These mobile agents will be used to provide users with the means to access and exchange information, in an ad-hoc and secure manner, while on the move. Multi-agent interaction protocols, such as negotiation and cooperation, will help preserve the security of the environment. Open hypermedia techniques, and in particular link services, will be investigated in order to deal with information management in this context; in particular, these techniques will be used to filter and present information according to the users' needs. Funded by EPSRC (under the DIM programme).

MobileVCE: Software Agents for Future Mobile Communication Environments

The research is investigating the role of intelligent and mobile agents in future generation, mobile communication environments. In particular, issues related to how agents can flexibly adapt their behaviour and their interactions to the characteristics of their current communication environment will be explored. Funded by the UK's Virtual Centre of Excellence in Mobile and Personal Communications.

Paradigma

Paradigma is a Jini-based framework that instantiates the formal agent framework developed within the group. It uses Jini connectivity technology to enable the dynamic discovery, communication and cooperation of agents and other resources on a network. The result is an implementation framework that facilitates rapid development of multi-agent systems whose operation can be clearly understood at both theoretical and practical levels, with each informing the other.

Practical Negotiation for Electronic Commerce

This EPSRC funded collaborative project aims to apply game theoretic techniques to the design of negotiation algorithms for use by autonomous software agents in electronic commerce. The other partners are the University of Liverpool (Mike Wooldridge) and the ESRC Centre for Economic Learning and Social Evolution (Ken Binmore and Nir Vulkan).

SoFAR

SoFAR (the Southampton Framework for Agent Research) is a versatile multi-agent framework designed for Distributed Information Management tasks. SoFAR embraces the

notion of proactivity as the opportunistic reuse of the services provided by other agents, and provides the means to enable agents to locate suitable service providers. SoFAR combines some ideas from the distributed computing community with the performative-based communications used in many agent systems: communications in SoFAR are based on the startpoint/endpoint paradigm, which is the foundation of Nexus, the communication layer at the heart of the Computational Grid. This is a modular approach which completely separates the modalities of communication from the intention of communication. As a result, several communication layers are supported by SoFAR. Furthermore, this technique was successfully used to encapsulate transparent routing of messages to mobile agents in SoFAR. A number of activities are centered around SoFAR, including delivering streams of metadata across the Internet, integration with Jini, scalable brokering, and auction protocols.

Team-Oriented Problem Solving

Formal investigation of the use of joint intentions in cooperative problem solving. Describes the cooperative process from detecting a need for cooperation, through team formation and planning, to execution. Show how such models can be used to ddesign and build architecture for cooperating agents. Funded by DERA Malvern.

In addition, the IAM Group is the coordinating site for the AgentLink Network of Excellence under the direction of Michael Luck; it is a member of the UK's Virtual Centre of Excellence in Personal and Mobile Communications; it is lead partner of the Interdisciplinary Research Collaboration (IRC) on Advanced Knowledge Technologies (AKT) which tackles fundamental problems associated with the management of knowledge under the direction of Nigel Shadbolt; and it is a participant in the Equator IRC to integrate the physical and digital worlds through technological innovation.
You can find out more about the IAM Group from the website at:
http://www.iam.ecs.soton.ac.uk

Site Report

Artificial Intelligence Group (AIG) at the University of York

Eduardo Alonso

Department of Computer Science, University of York, UK

ea@cs.york.ac.uk

The Artificial Intelligence Group was founded in October 1999 as a result of merging the Intelligent Systems and Machine Learning groups at the Department of Computer Science, University of York. Today the research group consists of seven faculty members, including the leaders of the group Professor Stephen Muggleton and Dr. Alan Frisch, and several postdoctoral researchers, and graduate and undergraduate students.

The agent related research in the IAG is focused on both micro/agent level and macro/ level issues in agent technology and agent system implementation issues. The development areas which benefit from our research are: Information gathering, management, and retrieval, Internet and WWW agents, expert assistants and human computer interfaces, simulation, and entertainment and virtual environments.

Specifically, there are two main lines of (multi)-agent research in our group:

- Adaption and learning in multi-agent scenarios, particularly in how to apply logic based learning techniques such as inductive logic programming to improve the effectiveness and adaptability of multi-agent systems;
- Application of agent techniques to computer graphics. In particular, this includes the development of information presentation systems populated by autonomous synthetic characters with which the user interacts in natural language.

The group's research is supported by numerous grants from EPSRC, BBSRC, Smith-Kline Beecham, and the European Commission. Moreover, the AIG has industrial links with DERA, British Telecommunications, Microsoft, and Rubus.

The Society for the Study of Artificial Intelligence and the Simulation of Behaviour is organising its next convention at York, 21st - 24th March 2001 (http://www.aisb.org.uk/2001convention). AISB-01's theme is ''Agents and Cognition''. The AIG group is organising a Symposium on Adaptive Agents and Multi-Agent Systems (http://www.cs.york.ac.uk/~kudenko/aisb01) as part of it.

The AIG is also member of another five European Networks of Excellence: Compulog Net (computational logic), ELSNET (language and speech), PLANET (AI planning), MLnet (machine learning), and ILPnet2 (inductive logic programming).

For more information visit our web page at http://www.cs.york.ac.uk/~ea/aig-agents-plo.html or contact Eduardo Alonso, ea@cs.york.ac.uk.

Trading Agents

Magnus Boman

Stockholm University and the Royal Institute of Technology, Kista, Sweden

mab@dsv.su.se

Formally one of the workshops at ICMAS 2000 in Boston, the Trading Agents Competition (TAC) was more a competition than a workshop. The very relaxed and professional arrangers Michael Wellman and Pete Wurman (from the University of Michigan and North Carolina State University, respectively) did their best to make the 50 or so attendants watch the research presentations, and not the applet showing the current game blown up on an overhead projector in the same room. To no avail, of course. But there were many games to be played before a winner could be identified, and all of the contestants happily adapted to the situation. Having attended many computer science competitions, I enjoyed the relative calm: no panic in the eyes of the contestants, no press, no pizza boxes; most of us even took our packed lunches to the nearby park and got a tan from the real sun rather than from the screens. I also ran back and forth to the high-paced and highly enjoyable discussions and presentations in the MABS workshop room through a conveniently located fire door.

This was the first TAC, but judging from the creative post-competition discussion, not the last. In fact, it seems likely that there will be another one in around 18 months, and the necessary rule revisions were fewer in number than most of us had anticipated. In part, this was due to the fact that TAC got underway long before the workshop was held. In April, most of the contestants were already programming, and the mailing list slowly started to pick up speed. In early June, the preliminary rounds were played, and the group of about 35 highly experimental competing agents were trimmed down to 22. The arrangers realised that the logistics of the one-day workshop allowed for a maximum of 12 competing agents, and another trimming was required. A round a qualification games were played at the end of June, leaving a dozen agents ready for the semi-final, to be held in the morning of the workshop itself.

But before I move to that final day, and to our topic as such, viz. whether there was any agent programming involved in TAC or not, let me give a brief description of the rules. I will borrow here from what is currently the most complete account of what it entails to program a TAC agent: the M.Sc. thesis of my student and team-mate Sven-Erik Ceedigh [Cee00]. A few short reports came out immediately after the workshop and can be found at tac.eecs.umich.edu/, together with the rules and results, and a full paper with team descriptions will be published shortly [Gre01]. Surely, the man-months of research and programming put in will make waves in agent workshops, conferences, and journals in the near future.

The TAC agents represent travel coordinators, the goal of which is to arrange travel packages for eight clients. These travel packages consist of flights, hotel rooms, and tickets to entertainment events, all of which the agents trade in electronic auctions. The competition was hosted on a version of the Michigan Internet AuctionBot server (at auction.eecs.umich.edu/). Agents communicate with the AuctionBot via a TCP-based API, supporting the development of trading agents in a variety of programming languages, the most popular of which was C++, followed by Java. Just to get some idea of the level of ambition: our own agent RiskPro (which finished seventh, as shown in the table of results below) consisted of 7000 lines and 20 classes of Java code. About 3000 of these lines were devoted to communication with the server.

Playing over the Internet has its pros and cons. For the arrangers, it meant decentralised control of the machines on which the TAC agents ran, not having to worry about how the agents connected to the server. The negative side naturally includes network congestion and uncontrollable loads, possibly resulting in unfair play due to difference in resources. Even so, there are two more ways of defending Internet play. Firstly, it is close to the real world in that most of these agents, should they ever be used, would act on the Internet. Second, it is possible to intelligently adjust to lack of resources by careful monitoring of network resources—in itself an interesting part of TAC game play, and of the design of trading agents.

At the start of each 15-minute game, agents receive an endowment of entertainment tickets that may either be sold, or distributed among the clients. The competition covers a total of five consecutive days, allowing clients to stay in Boston between one and four nights. The auctions differ not only by the type of good traded, but also by what day the goods are valid. The objective of the TAC agent is to obtain eight travel packages from the different auctions, and maximise the total satisfaction of its clients. The winning agent in a game is the one that achieves the highest sum of all individual customer utilities, while minimising the expenses for all the goods bought. TAC agents have no financial limitations and are therefore able to spend as much money as required to obtain goods in auctions, although a higher spending inevitably results in a reduced final score.

Pos.	Agent Name	Affiliation	Average Score
1	ATTac	AT&T Labs - Research	3398.26
2	RoxyBot	Brown Univ and NASA Ames	3283.24
3	aster	STAR Lab at InterTrust Technologies	3068.34
4	umbctac1	Univ of Maryland at Baltimore County	3050.99
5	ALTA	Artificial Life Inc.	2198.01
6	m_rajatish	Univ of Tulsa	1872.71
7	RiskPro	Stockholm Univ and the Royal Institute of Technology	1569.91
8	T1	Swedish Institute of Computer Science and Industrilogik	1167.40

Figure 1: Table of final results

The three types of goods are traded in separate auctions with different rules. This complicates the agent design problem by allowing agent developers to implement different bidding strategies for each type of auction. Even so, there are interdependencies as every client needs a hotel for every night between arrival and departure of the flight, and can attend entertainment events only during that interval. Client preferences are randomly distributed by the server for each new game, making machine learning difficult. At the end of the game, each TAC agent has acquired several tickets for flights, hotel rooms, and entertainment events. One of the key elements to achieving a high score, apart from producing a winning bidding strategy, is employing an efficient method for allocating these tickets to clients, in order to maximise the sum of all individual client utilities.

In an earlier report on RoboCup in this newsletter [Bom99], I posed the following question. When will agent programmers find the RoboCup domain useful for benchmarking, prototyping, and model alignment? That same question for TAC would probably be answered by "later, never, and never", but the goals (quoted here from tac.eecs.umich.edu) are different too:

1. Spurring research on common problems within the domain.
2. Promoting definitions of benchmarks and standard problem descriptions.
3. Showcasing research in this area to the MAS community and beyond.
4. Having fun.

While RoboCup went into pre-school for ICMAS2000, launching properly RoboCup Rescue (through a workshop, and an invited talk by Kitano), TAC is just a toddler. While TAC has no grand challenges or controversial long-term goals in the RoboCup fashion, its simpler and smaller scope and rules make possible a quick launch to industry and commercial applications. Given the increasing number of e-commerce agent patents registered, as well as the penetration in our own research areas of microeconomic theory, all doors are open for TAC. Of the above goals, the first and fourth are almost self-fulfilling: The first TAC was a success, and a thoroughly enjoyable event to attend. As with RoboCup, there will certainly be improvised mini-tournaments and perhaps regional competitions in the coming year. On the way to the second competition, TAC might become a standard problem.

The arrangers stayed away from the most obvious application problems, such as stock trading, portfolio management, and other financial applications, and deliberately stayed closer to the simpler problem of providing single-agent user assistance. The multi-agent problems do come in only in the interaction between the assistants, so an interesting question is what the interaction in TAC amounts to. Unfortunately, for MAS researchers, the answer is: little more than trying to stay tuned to the real-time scenario. There are very limited opportunities of any opponent modelling, as the actions of other agents are recognisable only as bidding behaviours. Thus, the state of each agent at any particular game instance carries little or no information about the other agents. Statistical measures such as activity levels and bid increases can be maintained and perhaps even used during the game, but the flavour is definitely single-agent. One important reason for MAS researchers to be interested in trading agents is for the agents to be able to recognise and model each other. Only then can reputation, trust, and coalition formation affect the design problem. For most Internet application developers, however, such advanced designs still reside at the bottom of the stack, under issues such as security, authentication, and law issues. Moreover, the open market structure of the Internet means that it is less suitable for advanced designs. The probability of encountering other agents often enough to recognise (let alone model) them is simply too low. This is not the case with intranets, and semi-closed markets (e.g., markets that require some form of membership). But TAC is now, and designing TAC agents means playing a game relevant mainly to simple single-agent designs for the Internet. For this reason, the arrangers also chose not to consider combinatorial (sometimes called combinational) auctions. Put simply, any good in any commodity bundle in a TAC game has a value independent of the other goods in the bundle. In real life, a shopping agent might want good A only if it can get good B; more generally, the willingness to pay for A will be affected by whether or not B can be obtained. In TAC, there are interdependencies. For instance, why pay for a flight ticket for a particular day, for which no hotel is available? These interdependencies are not handled in TAC by allowing agents to bid for bundles. Rather, TAC agents may be seen as acting on iterative auctions. Since bundle pricing and bidding in artificial agents is a rapidly increasing area of research, this could be a way of making TAC more difficult and interesting in the future. However, this summer there seemed to be a consensus that no such change should take place before the next competition. The leap would be too big.

So, what about the third goal? The co-location with ICMAS meant the audience was there, at least in theory, and anybody interested in the AMEC SIG of AgentLink should definitely scrutinise the upcoming team reports [Gre01]. I do not see, however, the MAS aspects of TAC to be the main reason for giving it attention, at least not now. Instead, I think it is an excellent way of approaching microeconomic theory from a computer science perspective. I have to some extent validated this myself, by discussing TAC during a spring graduate course (the basic facts of which are at dsv.su.se/~mab/mv00/). A discussion point at the TAC workshop was educational use of the game, and besides me, three people had already used TAC for educational purposes, generally with good results. While many agent papers deal with properties of artificial agent markets, TAC is also about properties of the agents themselves. During a game, agent design is the topic of study. In the post-game analysis, one may study the efficiency of the market. After having lived through a couple of years now with an absurd amount of papers on variations of the topic "which pieces of microeconomic theory can we borrow for agent and market design, so as not to reinvent the wheel?", it is time we moved on. TAC can help us move faster.

References

[Bom99] Magnus Boman: "Agent Programming in RoboCup'99", *AgentLink News* **4**: 20-22, 1999.

[Cee00] Sven-Erik Ceedigh: "Trading Agents", M.Sc. thesis, Dept of Computer & Systems Sciences, Stockholm University, 2000.

[Gre01] Amy Greenwald and Peter Stone (eds.): "The First International Trading Agent Competition—Autonomous Bidding Agents", IEEE Internet Computing, forthcoming.

ESAW'00 workshop on Engineering Societies in the Agents' World

[1]Andrea Omicini, [2]Robert Tolksdorf and [3]Franco Zambonelli

[1]University of Bologna, Italy. **aomicini@deis.unibo.it**

[2]Technische Universität Berlin, Germany. **tolk@cs.tu-berlin.de**

[3]University of Modena and Reggio Emilia, Italy. **franco.zambonelli@unimo.it**

The ESAW'00 workshop on "Engineering Societies in the Agents' World", held on 21st August 2000 in conjunction with the 14th European Conference on Artificial Intelligence in Berlin, Humboldt University, was devoted to discuss technologies, methodologies and models for the engineering of complex applications based on societies of agents.

In the near future, multitudes of autonomous software agents are expected to be deployed in networks and on the Web. These multi-agent systems (MAS) can no longer be conceived as static – multi-component – software architectures. Instead, due to the autonomous behaviour of agents and to the richness and dynamics of their interaction patterns, MAS can be better conceived in terms of artificial societies of individuals, living in and possibly roaming across a specific – often distributed – environment, and interacting according to patterns resembling those of human societies and/or complex eco-systems. Within that scenario, MAS are far beyond the boundaries of DAI, and research in the area of MAS should necessarily gather contributions from many different and heterogeneous areas.

By focusing on the social aspects of MAS, ESAW'00 aimed at concentrating on the space of agent interaction with a clear orientation on the technology and methodology issues, rather than on purely theoretical ones, and aimed at bringing together people and contributions from both within and outside the field of DAI, to promote cross-fertilisation of ideas.

In response to the ESAW'00 call for papers, twenty papers were received, which were peer-reviewed for scope and quality. The ten best submitted papers were accepted for presentation and discussed at the workshop. After a further phase of review and expansion, also meant to incorporate the results of the workshop discussion, the selected papers were included in the postproceedings published as LNAI 1972 by Springer Verlag.

The quality of presentations at ESAW'00 was high, and triggered a highly interesting discussion amongst the 25 participants of the workshop, which, as we hoped, came from different research communities — Social Science, DAI, Software Engineering, Distributed Systems — traditionally not cooperating too much with each other.

The central question of the discussion was what of the agent societies is to be modelled, and how should they be engineered. Around this very general question, several specific issues were addressed, relating to the engineering of emergent behaviours in agent societies, the modelling of the environment, and the requirements for the corresponding methodologies and standards.

Concerning the behaviour of agent societies, emergence seemed to be a central issue, and all the participants agreed that a theory of emergence may be needed for the engineering of complex agent systems.

Opposed to common assumptions in Software Engineering, any equilibria of the agent system are explicitly not accepted, and changing of roles is common. Since emergence seems to be outside the scope of prescriptive modelling, it was suggested that models of "indirect design" and languages for "indirect programming" could be defined and exploited to promote and affect the emergence of useful behaviours in complex systems. In this context, engineering the self-evolution of an agent system and enabling adaptation — e.g., by selection, learning, negotiation, or intervention of the environment — were considered as central challenges.

The study of emergent behaviours also focuses on the environment in which agents live, other than on agents themselves and their interaction. The importance of identifying and/or modelling the agents' environment led to another major thread of discussion. According to that, it was suggested that agent-based models should provide a view on MAS as something more than distributed systems, and also supply suitable abstractions to capture the environment in which they are situated.

In several cases, the environment in which a MAS is immersed should be considered as active. First, unforeseen interactions with the environment have to be expected, given that several real-world systems and applications live dipped in dynamic and unpredictable environments. Second, open agent systems intrinsically deal with environments that entities can enter and leave at any time: this suggests that an active environment could be naturally exploited to model an open system. Finally, it may sometimes be necessary to embed specific interaction laws within the environment: this raises the issue of the models and enabling technologies allowing such laws to be represented and enforced.

Due to its active nature, the environment might indeed be modelled as an agent, or as a set of agents. However, that may turn to be the wrong abstraction level for several kinds of applications, and in particular wherever it turns out to be useful or necessary to model and engineer agent-to-environment interactions separately from agent-to-agent interactions. There, an engineered approach to agent societies seems to require the adoption of the environment itself as a first-class abstraction in the design and development of agent societies.

Yet another issue discussed was that of modelling and design methodologies. While standard methodologies like UML could be adapted to model agent societies, it was unclear whether the current state of the UML technology is enough to capture all fundamental notions, and to express them at the most suitable level of abstraction. In this context, it was also stated that misusing abstractions as provided by standard methodologies can point to defects or lack of expressiveness in these abstractions.

ESAW'00 was one of the first attempts to put researchers from different areas together to discuss the multi-faceted issues that emerge in the engineering of complex systems as societies of agents. It provided many original and heterogeneous views on such an interdisciplinary topic, as well as several attempts to put everything together. It is planned that ESAW'00 will be only the first event of a series, meant to provide the agent community with a forum where novel ideas and results can be shared by crossing the boundaries of the many research and application areas that meet in the agent field.

What's Happening in AgentLink?

Michael Luck

Electronics and Computer Science, University of Southampton, UK

mml@ecs.soton.ac.uk

AgentLink II News

The AgentLink II contract has now been negotiated and signed. AgentLink II (AL2) officially began on 1st August 2000, with a small break between the end of AL1 and the start of AL2. The new site for AL2 is the Department of Electronics and Computer Science at the University of Southampton, and the new AgentLink Coordinator is Michael Luck.
Under the dynamic leadership and direction of Mike Wooldridge, and with the support of Hugo Brailsford, AgentLink has come to occupy a very significant place in the agent community. As we move into AL2, and with Mike's continuing contributions to AL2, we aim to build on the success of AL1.

AgentLink II Membership Agreements for Existing Nodes

The arrangements for membership of AgentLink II are not the same as AL1. AL2 is a distinct project, so all existing AgentLink nodes must complete and return signed membership agreements in order to retain membership. Details are available at http://www.agentlink.org/members/join-al2.html
In essence, all members are required to sign a membership agreement with the coordinator. Any institution that does not provide such a membership agreement cannot be a member of AgentLink II, and will not be eligible for AgentLink support or resources.
Most nodes have already returned these forms, but there are still several outstanding. It will still be possible to join AgentLink II later, but the benefits of membership will not apply retrospectively, and membership will only be possible from the date of the membership agreement itself.
The full list of nodes who are now members is available at www.agentlink.org/members/

AgentLink II New Membership Applications and New Countries

We are now open to new applications for membership from new organisations. Note that there are many new countries that are now eligible to join with full membership. Details are available at http://www.agentlink.org/members/newmembers-al2.html.
In particular, organisations in all European Union member states are eligible to apply, as are those in associated states, including: Bulgaria, the Czech Republic, the Republic of Cyprus, Estonia, Hungary, Iceland, Israel, Latvia, Liechtenstein, Lithuania, Norway, Poland, Romania, Slovakia and Slovenia.
We would like to encourage new applications from these new states in particular. If you have contacts or collaborate with people in these countries, please tell them about AgentLink and encourage them to apply.

AgentLink Meetings in Amsterdam (February 22-23, 2001)

AgentLink will hold the first major meeting of AgentLink II on 22nd and 23rd February in February, 2001, in the Netherlands at the University of Amsterdam.
The first day will involve plenary sessions, targetting industrial problems and interests in particular, with the second day being given over to breakout sessions for more focussed SIG meetings from the following SIGs. Please contact the SIG coordinators directly for details of the individual SIG programmes, and for participation details.

- Agent-Mediated Electronic Commerce Coordinator: Carles Sierra (sierra@iiia.csic.es)
- Agent-based social simulation Coordinator: Rosaria Conte (conte@www.ip.rm.cnr.it)
- Intelligent Information Agents Coordinator: Matthias Klusch (klusch@dfki.de)

Limited travel support is available for those participating in SIG meetings and in the plenary sessions. Please contact SIG organisers directly for information on how to participate, and/or check the SIG web pages at http://www.agentlink.org/activities/ for updates in due course.
We would also like to encourage participation from members new to SIGs both at the plenary sessions and the breakout sessions. Some support may also be available for members to attend the plenary session; details of this will be available soon.

Structure and Organisation of AgentLink Meetings

The AgentLink Management Committee has agreed a provisional schedule of meetings for AgentLink II as follows:

- Amsterdam, SIGs, February 2001 Prague,
- SIGs and Summer School, July 2001
- SIGs, Winter 2001/2
- Bologna, Summer School, 2002
- SIGs, Winter 2002/3

While the structure of the February 2001 meeting is relatively well-defined, we would welcome feedback on the ways in which you would like to see AgentLink move forward with future meetings. Please send comments and suggestions to coordinator@AgentLink.org. AgentLink is here to support its members and can only address the needs of its members if you contribute to the discussion.

AgentLink support for Workshops and Conferences

AgentLink has agreed to provide limited travel & subsistence support to student authors with papers accepted at the following events. Details of the application procedure will be given in the email AgentLink Update.

- i3net/AgentLink Workshop on Agent Coordination and Context-Adaptation in a World of Disappearing Computers, Porto, Portugal, April 24-25, 2001. http://aos2.uniba.it:8080/ws7-i3.html
- The Fifth International Conference on Autonomous Agents (AA 2001). Montreal, Canada, 28 May-1 June, 2001. http://www.csc.liv.ac.uk/~agents2001/
- The Fifth International Workshop on Cooperative Information Agents (CIA 2001). Modena, Italy. September 6-8, 2001. http://www.dfki.de/~klusch/cia2001.html.
- The Tenth European Workshop on Modelling Autonomous Agents in a Multi-Agent World (MAAMAW 2001).

EASSS 2001

The 3rd European Agent Systems Summer School will be held this year in collaboration with ECCAI's Advanced Course on Artificial Intelligence (ACAI-01), under the joint head-

ing of Multi-Agent Systems & Applications (MASAP).
MASAP is jointly organized by the Czech Technical University in Prague (CTU), the Czech Society for Cybernetics and Informatics (CSKI) and the Austrian Research Institute for Artificial Intelligence (OeFAI) in cooperation with ECCAI and AgentLink. Further half/full-day co-located events on related topics will be included, such as the ILPNet2 workshop on "Inductive Logic Programming and Agents".
AgentLink also plans to co-locate meetings at the same time.

The courses will present the current state of the art in the area of Multi-Agent Systems (MAS) as well as demonstrate the applicability of these systems in many practical tasks. Presentations will highlight different aspects and viewpoints of this recently established and very active scientific field, with the core formed by plenary invited mini-courses delivered by leading experts. MASAP will also include workshops, student sessions and panel discussions aimed at various problems related to MAS. The student sessions will provide an opportunity to present results and discuss students' work in progress – their proceedings will be published by CTU and OeFAI.
MASAP will be of benefit to professionals interested in the emerging technology of MAS as well as researchers and postgraduate students interested in the field.
Details of the summer school can be found at http://cyber.felk.cvut.cz/MASAP2001/

Report on European Agent Systems Summer School EASSS 2000

Matthias Klusch and Klaus Fischer

DFKI GmbH, Saarbruecken, Germany

klusch@dfki.de

The second AgentLink European summer school on agent systems (EASSS 2000) took place in Saarbrücken, Germany, from Augst 14 – 18 on the campus of the university of the Saarland. This annual event marks a particular highlight in Europe's fierce efforts in R&D in agent technology which is worldwidely noticed (www.agentlink.org). This year the school was hosted by the German research center for AI (DFKI GmbH, www.dfki.de/) and the Universität des Saarlandes (www.uni-sb.de/Welcome.html.en). The excellent mixture of in total 13 introductory and advanced courses covered the full range of theoretical and practical aspects of agent-based computing as it can be seen from the following list of courses. Each of the courses has been presented by a leading expert in the field; all courses have been very well received and evaluated in general by the 112 students as well as by 32 and 20 participants from academia and industry, respectively.

1. Foundations of Intelligent Agents (Mike Wooldridge, University of Liverpool, UK)
2. Foundations of Multiagent Systems (Yves Demazeau, Leibniz/IMAG, France)
3. Logical Foundations of Agent Systems (Wiebe van der Hoek, University of Utrecht, Netherlands)
4. Problem Solving and Planning (Klaus Fischer, DFKI GmbH, Germany)
5. Coordination, Communication, Collaboration (Franco Zambonelli, University of Modena, Italy)
6. Learning Agents (Sandip Sen, University of Tulsa, USA)
7. Interface Agents (Elisabeth Andre, DFKI GmbH, Germany)
8. Mobile Agents and Security (Christian Tschudin, University of Uppsala, Sweden; Volker Roth, Fraunhofer, Germany)
9. Agent-oriented Software Engineering (Jan Treur, Free University of Amsterdam, Netherlands)
10. Idustrial Applications of Agents (Van Parunak, ERIM Center, USA)
11. Intelligent Information Agents (Matthias Klusch, DFKI GmbH, Germany)
12. Behavior-oriented Control of Physical Agents (Thomas Christaller; Hans-Ulrich Kobialka, GMD, Germany)
13. Societies of Artificial Agents and Social Simulation (Paul Davidsson, University of Karlskrona-Ronneby, Sweden)

Each of the first three days closed with excellent invited talks given by Wolfgang Wahlster (DFKI) on the generation of virtual Web pages, Jörg Siekmann (DFKI) on holonic multi-agent systems, and Sarit Kraus (University of Maryland, USA) on challenges of and techniques for coordination and cooperation in multi-agent systems. Particular highlights of the summer school have been the social events such as the welcome reception with french sparkling whine, beer, and several tasty sorts of quiche lorraine; a big barbecue party with a really good live band "All That" which played right thru the night, a guided city tour through modern and old city of Saarbrücken plus welcome reception by the Lord Major at the town hall, and a lecturers'dinner at a distinguished wine house.
The EASSS 2000 was jointly chaired by Mike Wooldridge (University of Liverpool, UK), Michael Luck (University of Southampton, UK) as coordinator of AgentLink II and Gerhard Weiß (TU Munich). Local co-organizers of this event were Klaus Fischer and Matthias Klusch (DFKI GmbH) who have been greatly

The Lord Mayor of Saarbrücken city, Hajo Hoffmann, talking to participants of EASSS.

The Lord Mayor of Saarbrücken city with the AgentLink coordinator, Michael Luck of the University of Southampton, and one of the EASSS' local co-organizers Matthias Klusch of DFKI.

supported in particular by the local team of KWT (www.uni-saarland.de/verwalt/kwt), Jasmin Schneider (www.jasmin-design.de/) and the Multiagent Systems group at DFKI. The organizers are also indebted to the sponsors Dresdner Bank, DaimlerChrysler AG, SAP Retail Solutions and Siemens AG who helped to make this important event happen.

The countries of origin of the 164 registered participants of the summer school were not restricted to the European Union (Germany 47, England 26, Italy 15, France 11, Netherlands 9, Spain 8, Portugal 5, Sweden, Austria and Belgium 3 each, and Czech Republic, Finland, Luxemburg, Switzerland, Norway, Poland, Slovenia and Russia 1 each) but also world-wide (USA 15 due to funding by NSF, Argentina and Singapore 2 each, Guinea, Mexico, Australia and Israel 1 each).

According to the opinions of most participants this year's summer school on agents has been a great success not only due to the intensive debates, interesting high-quality courses but also the social events and helpful local assistance. Everything went smooth, the weather was mild, cloudy, partly sunny, and as far as we know of people enjoyed being at this summer school and in Saarbrücken. More detailed information on the EASSS 2000 can be obtained in the Web at www.dfki.de/easss/.

The next summer school is planned to be incorporated with the ECCAI summer school in Prague, July 2 – 7, 2001. For more information on the EASSS 2001 please contact Michael Luck (coordinator@agentlink.org).

New Call for technology take-up project proposals for innovative users and suppliers of agent technologies or middleware for distributed applications

Max Lemke

max.lemke@cec.eu.int

Agent technologies and middleware for distributed applications are becoming increasingly important in areas such as advanced telecom services, application services provision, community computing, and the integration of legacy systems. In order to accelerate take-up of these technologies in all industrial and services sectors, in January 2001 the European Commission plans to open another Call for Trial and Best Practice proposals with a tentative closing in April 2001. Users known as early adopters or early majority in the technology adoption curve would adapt, introduce and evaluate the above technologies in their applications. Depending on the maturity of the respective technology, they would team up with one or more technology providers or experts. For more information on this Call for take-up proposals and related Calls for R&D proposals in early 2001, please refer to http://www.cordis.lu/ist/ka4/ipcn/take-up.htm.

For users and suppliers: TRIAL projects aiming at the adaption and introduction of leading edge technology (promising but not yet fully established) in industrial/service applications and its joint evaluation;

For users: BEST PRACTICE projects promoting improvements in the practices, processes and operations in industry and services through the take-up of well-founded, mature and established (but insufficiently deployed) methods and technologies, so as to achieve greater efficiency, higher quality and greater economy.

The following technical areas are covered:

1. Adaptation and introduction of mobile and intelligent agent technologies to new services and industrial applications. This includes for example service creation, information filtering, electronic commerce, or network management applications. Users could be on all levels of the value chain ranging from network operators, to service providers or businesses trading electronically.
2. Adaptation and introduction of middleware for distributed applications with shared resources to new services and industrial applications. This includes for example technologies such as distributed object broker architectures, application and integration servers, or web integration. Applications could cover a broad range including for example web-based distributed applications, or the use of distributed object broker architectures for component-based integration with legacy systems on corporate or virtual enterprise levels.
3. Introduction and intelligent integration of embedded vision and/or control systems in production environments, with a focus on low cost off-the-shelf components, and integrated networked systems in industrial application in all sectors.

Individual take-up projects can only reach a limited proportion of European industries and services directly. Their full impact can only be achieved by a multiplier effect, realised through dissemination of a critical mass of results and experiences gained, and collective, pro-active and focused stimulation of further transfer, replication and re-deployment across borders and industrial/services sectors. Proposers should therefore be prepared to being clustered with successful proposals related to the same theme. In practice, this means that projects addressing a particular theme will be executed under a single contract, with horizontal work packages on dissemination and co-ordination. As a result of a previous Call, two such project clusters were created under the themes “Integrated Machine Vision” and “Technologies for Medical Applications”. With the selected proposals of the Calls closing in October 2000 and April 2001, it is envisaged to possibly extend these clusters and to create new ones within the above scope.

For any queries related to the content of your proposal, to the composition of consortia, or to budgetary aspects, please contact

Tom Clausen,
European Commission,
DG INFSO-E1,
Tel. (32-2) 29-94942,
Fax (32-2) 29-68389,
tom.clausen@cec.eu.int
or
Max Lemke,
European Commission,
DG INFSO-E1,
Tel. (32-2) 29-91575,
Fax (32-2) 29-68389,
max.lemke@cec.eu.int

2001		
MA 2001	5th International Conference on Mobile Agents Atlanta, Georgia, USA.	December 2-4, 2001 http://www.cs.dartmouth.edu/MA2001/
ICDM '01	The 2001 IEEE International Conference on Data Mining Silicon Valley, California, USA.	November 29-December 2, 2001 http://kais.mines.edu/~xwu/icdm/icdm-01.html
WI'2001	The First Asia-Pacific Conference on Web Intelligence Maebashi City, Japan.	October 23-26, 2001 http://kis.maebashi-it.ac.jp/wi01
IAT - 2001	The Second Asia-Pacific Conference on Intelligent Agent Technology Maebashi City, Japan.	October 23-26, 2001 http://kis.maebashi-it.ac.jp/iat01
DI-TESA'2001	International Symposium on Distributed Intelligence in Technology, Economic and Social Applications Rochester, New York, USA.	September 24-27, 2001 http://www.icsc.ab.ca/ditesa2001.htm
CIA-2001	Fifth International Workshop on Cooperative Information Agents Modena, Italy.	September 6-8, 2001 http://www.dfki.de/~klusch/cia2001.html
CoopIS 2001	Sixth International Conference on Cooperative Information Systems, Trento, Italy.	September 5-7, 2001 http://www.science.unitn.it/coopis/
IJCAI-01	Seventeenth International Joint Conference on Artificial Intelligence, Seattle, Washington, USA.	August 4-10, 2001 http://www.boeing.com/nosearch/ijcai/index.html
IJCAI-01	Autonomy , Delegation, and Control: Interacting with Autonomous Agents A workshop at IJCAI-01 Seattle, Washignton, USA	August 6, 2001 http://csce.uark.edu/~hexmoor/AA01/IJCAI01-cfp.htm
	Sixth International Conference on Computer Supported Cooperative Work in Design London, Ontario, Canada.	July 12-15, 2001 http://web.cscwid.org
Agents 2001	Fifth International Conference on Autonomous Agents Montreal, Canada	28 May-1 June, 2001 http://www.csc.liv.ac.uk/~agents2001/
ICAIL-2001	Workshop on Regulated Electronic Societies St. Louis, USA.	25 May, 2001 http://www.cs.uu.nl/people/henry/workshop3.html
ICAIL-2001	8th International Conference on Artificial Intelligence and Law St. Louis, USA.	21-25 May, 2001 http://www.cs.wustl.edu/icail2001/
	International Workshop on Applied Reliable Group Communication In conjunction with Int'l Conf. on Distributed Computing Systems SunBurst, Scottsdale, Arizona, USA.	April 16 - 19, 2001 http://wargc2001.di.fc.ul.pt
ETAPS	Workshop: Models and Methods of Analysis for Agent Based Systems, Genova, Italy	7 April, 2001 http://www.dai.ed.ac.uk/groups/ssp/etaps2001/
2001 AAAI	The 2001 AAAI Spring Symposium Series Stanford, California, USA.	March 26-28, 2001 http://www.aaai.org/Symposia/ Spring/2001/sss-01.html
ISADS 2001	Fifth International Symposium on Autonomous Decentralized Systems, Dallas, Texas, USA.	26-28 March, 2001 http://isads.utdallas.edu/
AISB'01	AISB Symposium on Adaptive Agents and Multi-Agent Systems York, UK.	21-24 March, 2001 http://www-users.cs.york.ac.uk/~kudenko/aisb01/
AISB'01	AISB Symposium on Information Agents for E-Commerce York, UK.	21-24 March, 2001 http://lima.soi.city.ac.uk/aisb/cfp.htm
AISB'01	AISB Symposium on Software mobility and adaptive behaviour York, UK. 21-24 March, 2001	21-24 March, 2001 http://www.ecs.soton.ac.uk/~lavm/aisb/cfp.html
	The Spanish-Portuguese Workshop on Physical Agents Madrid, Spain.	15-16 March, 2001 http://gsyc.escet.urjc.es/actividades/ waf-2001/en-index.html
SAC 2001	2001 ACM Symposium on Applied Computing, Special Track on Coordination Models, Languages & Applications Las Vegas, NV, USA.	11-14 March, 2001 http://lia.deis.unibo.it/confs/SAC01/
SCAI'01	The Seventh Scandinavian Conference on Artificial Intelligence Odense, Denmark.	February 19-21, 2001 http://www.mip.sdu.dk/scai01/

About *AgentLink News*

The aim of the AgentLink newsletter is to provide a relatively informal way of communicating both what's happening in AgentLink, but also what's happening in the agent world generally. Many newsletters end up being rather dull. (Let's face it, the very name "newsletter" puts many people off.) AgentLink News aims to be different. In addition to containing the worthy-but-dull details of what's happening in the network, we aim to carry a range of articles including features, reports on conferences and workshops, informal descriptions of research results and new software, book reviews, and so on. Of course, we can't do this without your help! We need you to generate the content for the newsletter. If you are interested in writing something for the newsletter, please get in touch with the editor Paul Davidsson directly, at the address below. The deadline for receipt of articles for issue seven is 15th March 2001. Remember: AgentLink news is not an academic journal, so we won't publish academic articles. Pieces should follow the conventions of similar sorts of publications (such as AI Magazine, or IEEE Internet), and be relaxed in style, with short lists of references, etc. Length is also an issue – features should be no more than a few pages.

The newsletter will have a circulation of up to several thousand. It's an ideal way to communicate your work to a specialist community, who will want to hear about it. So why not contribute?

How to Contact AgentLink

AgentLink II General Coordinator
Michael Luck
Department of Electronics and Computer Science
University of Southampton
Highfield, Southampton SO17 1BJ
United Kingdom
Email: coordinator@AgentLink.org

AgentLink II Associate Coordinator
Michael Wooldridge
Department of Computer Science
University of Liverpool
Liverpool L69 7ZF
United Kingdom

Industrial Action (workpackage 1) Coordinator
Joerg P. Mueller
Siemens AG
ZT IK 6
D-81730 Munich
Germany
Email: joerg.mueller@mchp.siemens.de

Research (workpackage 2) Coordinator
Yves Demazeau
Laboratoire LEIBNIZ - Institut IMAG
46, avenue Felix Viallet
38000 Grenoble
France
Email: Yves.Demazeau@imag.fr

Teaching & Training (workpackage 3) Coordinator
Gerhard Weiss
Institut fuer Informatik
Technisch Universitaet Muenchen
D-80290 Munich
Germany
Email: weissg@informatik.tu-muenchen.de

AgentLink News Editor
Paul Davidsson
Department of Computer Science
Blekinge Institute of Technology
372 25 Ronneby
Sweden
Email: Paul.Davidsson@ipd.hk-r.se

Typeset by Christopher Havill