AgentLink II:

Continuation of a Network of Excellence for Agent-Based Computing

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Year One Report

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1. SUMMARY

In August 2000, the European Commission began funding **AgentLink II**: *Continuation of a Network of Excellence for Agent-based Computing*, which followed on from the earlier **AgentLink** project from 1998 until 2000. (For convenience, we will sometimes refer to AgentLink II as AgentLink, but will always distinguish the first project as AgentLink I.) Agent technology is an important new area of information technology concerned with the construction of computer systems composed of one or more semi-autonomous computer systems known as agents. AgentLink II was funded for 36 months. This report summarises the activities of AgentLink II in its first year of activity. The key successes of AgentLink II in this first year may be summarised as follows.

- In terms of membership, AgentLink II enumerated 83 members in the first three months (at startup), largely comprising members of AgentLink I. Membership has since grown to 131 full members currently, with a growing number of "associate" members from both Europe and elsewhere.

- AgentLink II has established five "Special Interest Groups", continuing activity from AgentLink I, which focus the activities of the network on strategically important sub-fields of agent technology

    - SIG01: Agent-mediated electronic commerce

    - SIG02: Methodologies and software engineering for agent systems

    - SIG03: Intelligent information agents

    - SIG04: Agent-based social simulation

    - SIG05: Special Interest Group on Intelligent and mobile agents for telecommunications and the Internet

    These SIGs, which were established by a process of reviewed applications in AgentLink I, meet regularly to discuss key issues. They provide the core of AgentLink's meetings and public activities, and will provide the necessary technical input to generate the network's technological roadmap.

- AgentLink organised two major major international summer schools on agent technology, the first entirely run by AgentLink, and the second in collaboration with ECCAI's Advanced Course on Artificial Intelligence. Together, these summer schools offered 39 courses on agent technology to over 380 delegates from across the world. AgentLink II financially supported a number of students to attend this event, but in addition, the vast majority of delegates paid for themselves to attend. In 2000, the event attracted student sponsorship from the National Science Foundation in the USA and, over both events, students came from as far afield as Argentina, Australia, Ghana, Guinea, Malaysia and Singapore.

- AgentLink supported a number of high-profile international conferences and more focussed workshops, including "reactive" workshops designed to respond in a timely fashion to topical issues in agent technology

- AgentLink continued its publication of AgentLink News, now redesigned to appeal to a wider audience, and to engage the commercial and industrial sectors in particular. The magazine is distributed in hardcopy form to a distribution list that is continually being updated and expanded, currently standing at about 300, and at conferences and workshops, as well as being freely available in electronic form via the WWW.

- AgentLink continued its monthly email-based "update", to keep members (and others) informed of the progress and activities of the network.

- The AgentLink management committee to guide the activities of the network, continues to meet at regular intervals**.**

2. AIMS AND OBJECTIVES OF AGENTLINK

2.1 Background: What is Agent Technology?

Agent-based systems are one of the most vibrant and important areas of research and development to have emerged in information technology in the 1990s. Put at its simplest, an agent is a computer system that is capable of flexible autonomous action in dynamic, unpredictable, typically multi-agent domains. Many observers believe that agents represent the most important new paradigm for software development since object-orientation. The concept of an intelligent agent has found currency in a diverse range of sub-disciplines of information technology, including computer networks, software engineering, object-oriented programming, artificial intelligence, human-computer interaction, distributed and concurrent systems, mobile systems, telematics, computer-supported cooperative work, control systems, and electronic commerce.

Because of the horizontal nature of agent technology, it is likely that the successful European adoption of agent technology in these areas will have a profound, long-term impact both on the competitiveness and viability of European IT industries, and also on the way in which future computer systems will be conceptualised and implemented.

2.2 Aims of AgentLink

The aims of AgentLink are:

- to gain competitive advantage for European industry by promoting and raising awareness of agent systems technology;
- to facilitate improvement in the quality, profile, and industrial relevance of European research in the area of agent-based computer systems;
- to promote excellence of teaching and training in the area of agent-based systems;
- to provide a widely known, high-quality European forum in which current issues, problems, and solutions in the research and development of agent-based computer systems may be debated, discussed, and resolved.

In order to achieve these goals, AgentLink II was formed to:

- actively promote awareness of agent research and development activities within European industry by means of an industrial awareness programme, drawing attention to the potential advantages of agent-based solutions and describing the scope of agent-systems technology;
- encourage technology transfer from academia to industry, by supporting industrial-academic meetings and pump-priming technology transfer collaborations, particularly with respect to the IST programme;
- promote the adoption of standards and the awareness of standardisation activities in the area of agent technology;

- provide support for innovative, high-quality conferences and workshops related to agent systems research, technology, and applications;

- create a pan-European infrastructure for teaching and training in the area of agent-based systems, disseminating curricula, reading lists, courses, and teaching materials;

- establish and maintain databases that map agent-based systems research and development skills to researchers and practitioners across Europe;

- establish high-quality channels of communication on research, technology, and application aspects of agent-based systems, including a dedicated World-Wide Web (WWW) site, email list, and printed newsletter.

3. ORGANISATION, MANAGEMENT AND MEMBERSHIP

3.1 The Organisation of AgentLink

The activities of AgentLink are organised into five workpackages, with each workpackage having a coordinator (or several coordinators for WP4: SIGs) to oversee activities.

- WP1 — Industrial action: focussing primarily on the transfer of agent technology from academia to industry, the transfer of user requirements from industry to academia, and promoting best practice in agent systems development. Coordinator: Jörg Müller, Siemens AG, Germany.

- WP2 — Research coordination: focussing primarily on the promotion of excellence in European agent research, and establishing new research communities in promising, valuable areas of research. Coordinator: Yves Demazeau, LIFIA/IMAG, France.

- WP3 — Education and training: focussing on building agent technology development and research skills in students and researchers, and providing an infrastructure for teaching and research in agent-based systems. Coordinator: Wiebe van der Hoek, Universiteit Amsterdam, The Netherlands.

- WP4 — Special Interest Groups: focussing on the development of communities around areas of strategic importance and providing input to the management committee from the SIG members, as well as developing the technological roadmap. Each SIG has its own coordinator.

- WP5 — information infrastructure: focussing primarily on the creation of a management and communication infrastructure through which the work of AgentLink can efficiently be carried out. Coordinator: Michael Luck, University of Southampton, UK.

In order to carry out the work of the workpackage, each workpackage coordinator convened a “work package committee”.

3.2 AgentLink Management Structure

In order to manage AgentLink, a management/steering committee was established, made up of internationally recognised researchers and leading industrialists. This management committee meets at regular intervals to provide strategic guidance to the network’s decision-making process. The management committee is made up as follows:

- The coordinators of the network

- The coordinators of each workpackage

- The coordinators of each special interest group (SIG)
- The members of each workpackage committee

This means that the management committee has a membership of 10-15 in total. The management committee met three times in the first year of the project:

- 21 November 2000 - London, United Kingdom
- 22 February 2001 - Amsterdam, The Netherlands
- 9 July 2001 - Prague, Czech Republic

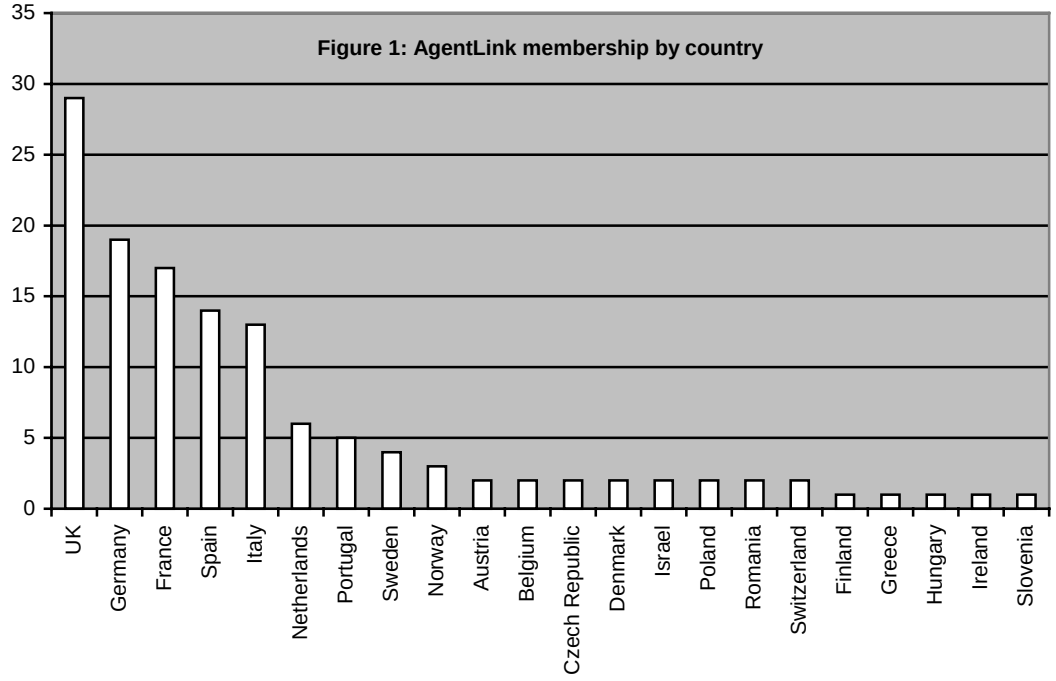
Minutes were taken of each meeting and are attached as Appendix A of this document.

3.3 Membership

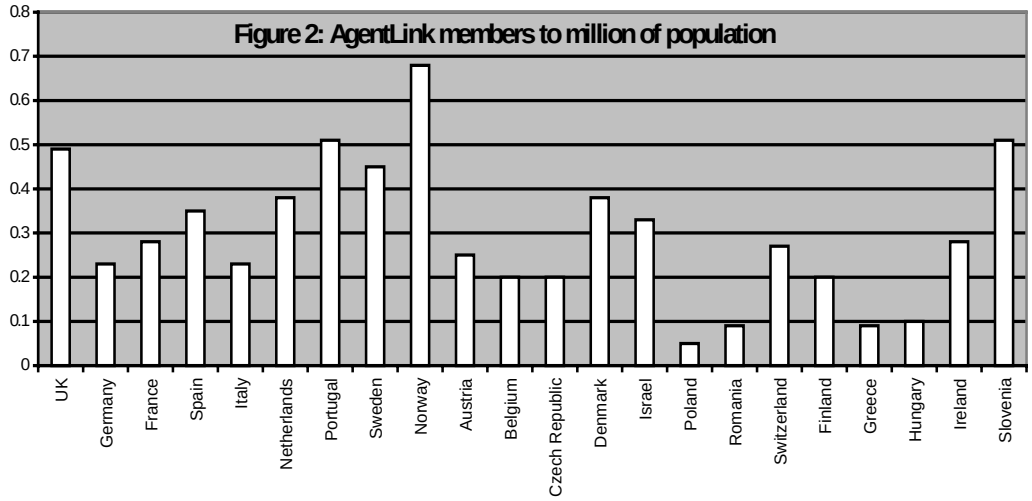
The desire to create an open network was always an important goal of AgentLink I, and AgentLink II has continued in attracting an extensive and broad membership. In just a year, AgentLink has increased in size by over 50%, from the original 83 after 3 months, to 131. The immense interest in membership of AgentLink is one of the most powerful indicators that AgentLink is regarded as an important development by the agent R&D community. AgentLink has advertised its activities through various mailing lists and conferences, and any institution that satisfies the European Commission's rules for membership can apply for membership. Applicants must make a case for why they should be members of such a network, and in particular, academic nodes must demonstrate excellence in the area of agent technology. Applications are reviewed by the management committee to ensure quality control. Appendix B provides a complete list of current members.

AgentLink II is now a year old, and in that year, the network has grown from 83 members to 131. In order to understand the reach of AgentLink, we have undertaken an analysis of network members. The results provide limited information, but they do at least give an indication of who is doing agent R&D, and where this is happening.

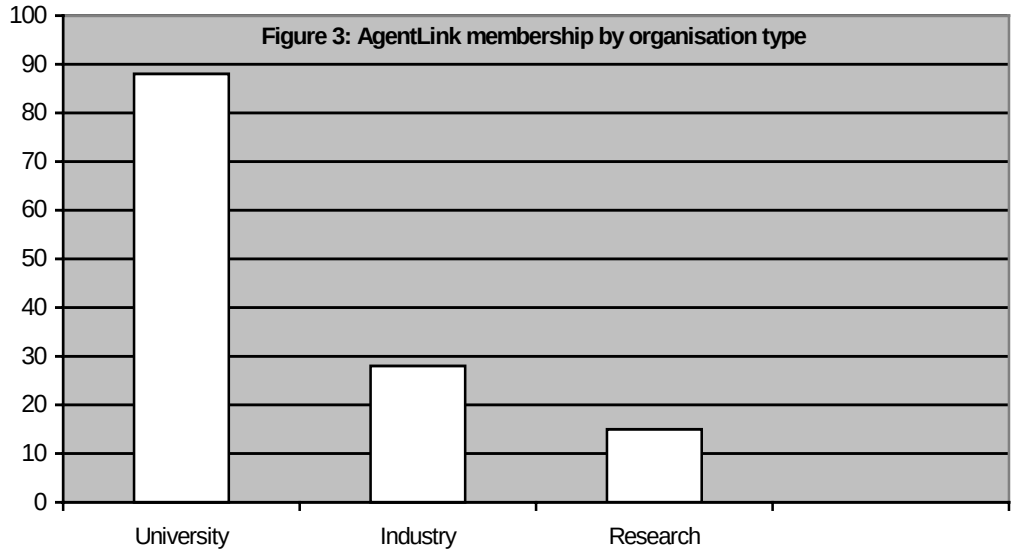
The most obvious analysis we can do is to look at number of members of AgentLink by country – see Figure 1. The UK, and then Germany, France, Spain and Italy clearly have the strongest showing; the UK figure is particularly high. Perhaps the most encouraging single



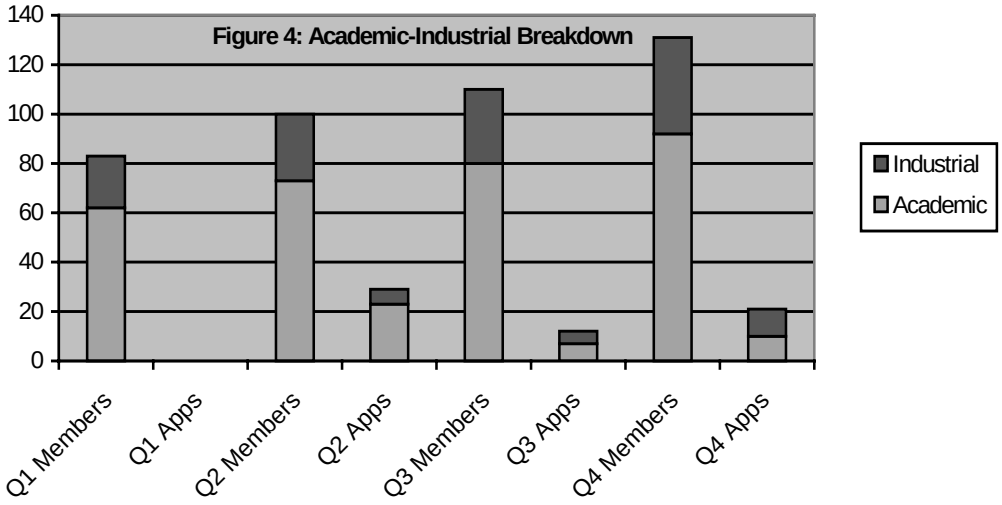
observation we can make is that Europe is now well covered by AgentLink – we have representation and activity throughout the region, including newly associated states such as the Czech Republic, Hungary, Poland, Romania, and Slovenia. Perhaps more enlightening is to look at the number of AgentLink nodes per million of population. Figure 2 shows these values. Belgium, the Czech Republic, Poland, Romania, Finland, Greece and Hungary are all relatively weaker, while the UK, Portugal, Norway, Sweden and Slovenia are all particularly strong. The deviations are not great, however; most countries seem to have a representation approximately on par with their population size, and newly associated states are coming into the field.



We also examined the membership of AgentLink by organisation type (university, industry, research institute, or public administration). The results are shown in Figure 3. At present, AgentLink has 67% university membership. Industrial nodes account for about 21%, with another 12% from research institutes. Clearly, we are doing well in attracting academic members, but our aim is to target industrial nodes, and this level is a little disappointing.



However, it is worth noting that the levels of industrial participation in the network are substantially higher than at the end of the first year of AgentLink I (29 in AgentLink II against 25 in AgentLink I).



The key difficulty in recruiting industrial members relates to ensuring that an appropriate and relevant message is delivered. We need to ensure that we speak the right language and avoid overly academic interactions. Efforts in this respect are already underway, with the substantial redevelopment of the AgentLink website, and the redesign of the newsletter. Further efforts in this direction are already underway, with new publicity materials being planned, and targeted events already in discussion with professional PR advice and input. The next phase of AgentLink II recruitment will focus primarily on industrial members, and Newly Associated States, but there will inevitably be more members from academia. Clearly, however, there are still many potential industrial participants who either do not know about AgentLink, or else do not know about agent technology. Accordingly, a major thrust of the industrial action component of AgentLink over the coming months will involve raising awareness with such potential members. It seems that the academic community is largely aware of AgentLink and joined quickly, while the industrial sector will take more time. Indications from the breakdown of trends of academic and industrial membership and applications by quarter in Figure 4 do, however, show that the balance is shifting, with more applications being received from industrial organisations in the fourth quarter. These are good signs. Although we have made a strong start, there is still a long way to go in ensuring that the community at large really do understand how AgentLink can serve them.

4.COMMUNICATION AND INFRASTRUCTURE ACTIVITIES

4.1 The AgentLink WWW Site

It goes without saying that the World-Wide Web (WWW) forms a key component of the information infrastructure of a European-wide network of excellence. To this end, the Internet domain name AgentLink.org, which was registered by AgentLink I in May 1998, was transferred to AgentLink II, and a seamless transition effected between WWW servers. The information provided on the WWW site has dramatically increased in the first year of AgentLink II, and now has repositories for agent software, publications, and member information that are becoming increasingly populated. The WWW server provides:

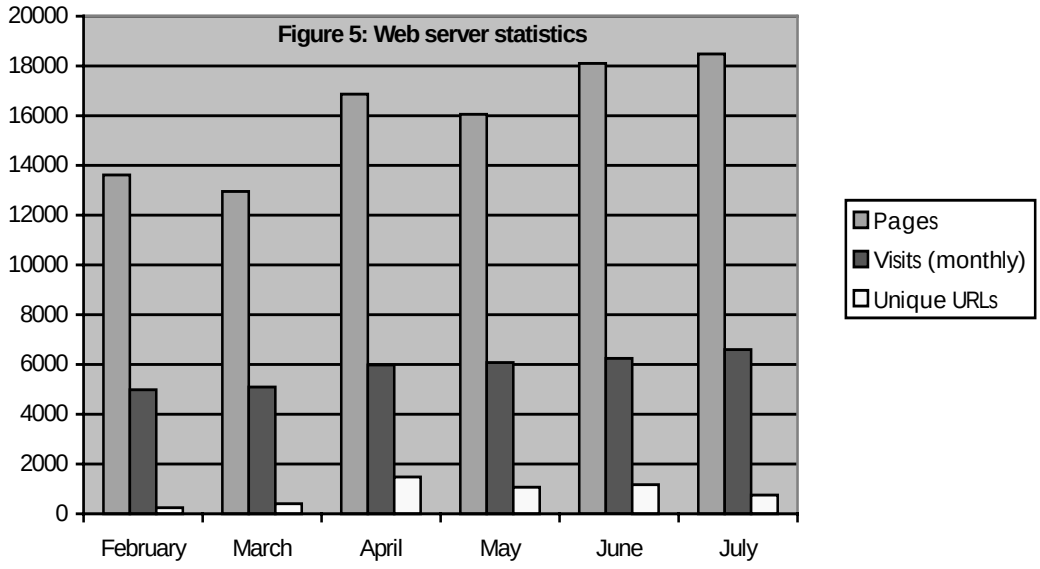
- information on all AgentLink activities;
- all publicly available AgentLink documents (including the newsletter);
- resources for the community:
    - an improved people finder;
    - a complete, up to date list of agent-related events;

- a curricula database for agent courses;
- a publications repository;
- an enhanced agent projects database;
- and a set of newly added pages:
  - an agent software database;
  - an *educational* software and demo database;
  - a members map and individual member research profiles;
  - Agent Standards;
  - an Agent Jobfinder;
  - IST Calls for proposals;
  - an Inter-Network page;

- information on how to apply for membership; and
- administrative information (e.g., how to claim back expenses for AgentLink events).

In particular, the website has undergone a substantial re-design which, together with the addition of many new resources as indicated above, has improved the site remarkably. The indications and site statistics reveal that these areas have begun to attract an increase in traffic to the site. To some degree, this may be the result of new navigation and enhanced usability. The overall emphasis of the site has now shifted towards establishing itself as a resource of value to industrial as well as the academic agent communities. For example, new database areas such as 'agent software' both commercial and educational are in the top ten ports of entry.

Web server statistics are shown in Figure 4, and illustrate pages, visits and unique URLs hit each month. The most useful measure to use is *visits*, which is not subject to change due to design modifications as are the other measures, and it clearly shows a sustained monthly increase in traffic.



4.2 The AgentLink Update Mailing List

The AgentLink WWW site provides a useful but essentially passive mechanism for keeping members up to date with AgentLink activities. In order to provide a more "pro-active" communications mechanism, a regular (monthly) email list was established. This email list is publicly available (anyone can subscribe, not just members), and currently has approximately 600 subscribers. In order to ensure a high signal to noise ratio, emails are sent in a "digest" form, with a number of short items in each monthly mail.

4.3 The Newsletter

The AgentLink newsletter was the first agent-related magazine. The newsletter aims to combine features on agent technology of general interest (informal summaries of important research results, book reviews, conference and workshop reports etc) together with news about the network and its activities. The newsletter is edited by Paul Davidsson, and designed and typeset by the AgentLink web and publications coordinator, Elizabeth Coulter-Smith. In the first year of the project, three issues of the newsletter were printed, one with content dating back to May 2000 but printed in November 2000, and the others from January 2001 and June 2001. The contents of these issues may be found in Appendix C of this document.

The aim of the newsletter is to engage with the broader IT community, who we see as its primary "market", as well as being of interest to academics. While the original magazine design was adequate, it was perhaps still lacking in impact. With the arrival of our talented web and publications coordinator, the newsletter was almost entirely redesigned for the June 2001 issue to give it a much punchier style, and to reach a wider audience.

Copies of the newsletter are distributed in a variety of ways. Hard copies are sent to a distribution list that is approximately 300 strong and growing, across Europe (including Central and Eastern Europe) and the rest of the world. They are also distributed at academic and industrial conferences, as a means of disseminating reports on agent-related activity, and of soliciting membership enquiries. Electronic copies of the newsletter are also available from the AgentLink website. In the first year of AgentLink II, around 5000 copies of different newsletters have been distributed, including 1500 printed copies.

5. MEETINGS AND WORKSHOPS

In its first year, AgentLink II supported several significant workshops and conferences:

Practical Reasoning Agents, London, UK, September 2000

> Practical Reasoning Agents was a workshop held at the same time as the Conference on Formal and Applied Practical Reasoning, continuing earlier efforts in AgentLink on the connections between logic and agents. AgentLink supported the event by funding 5 people to attend.

AISB 2001, York, UK, April 2001

> The Convention of the Society for the Study of Artificial Intelligence and the Simulation of Behaviour, held biennially. The theme of the AISB-01 was "Agents and Cognition" with the intention to bring together agent-based technologies and various cognitive aspects of Artificial Intelligence. 6 symposia were organized on different aspects of agents, with 204 delegates from 20 countries. AgentLink supported the event with about 1000 Euros, which was used to fund an invited speaker (Enric Plaza from Spain.

MAAMAW 2001, Annecy, France, May 2001

> The European workshop on agents, usually held annually. AgentLink supported the event with about 4000 Euros, of which 1000 was used to fund invited speakers (Paolo

Ciancarini from Italy and Jacques Ferber from France) and 3000 was used for funding student participants. The event was attended by about 60 delegates.

Autonomous Agents 2001, Montreal, Canada, May 2001

Autonomous Agents was a major international forum for agent research, and was the single largest agent event in 2001. AgentLink provided student travel grants to the total of about 4000 Euros for 7 students.

Agent-Oriented Information Systems, Interlaken, Switzerland, June 2001

The Agent-Oriented Information Systems workshop, held annually, in two locations. The workshop seeks to bridge the gap between information systems and agents. AgentLink agreed to provide up to 1000 Euros funding to support the European workshop, for organization costs.

6. SPECIAL INTEREST GROUPS (SIGS)

One of the main activities of AgentLink is the organisation of a number of Special Interest Groups (SIGs). These SIGs take the form of a series of meetings of interested parties, which AgentLink provides financial support for (room bookings and travel), as well as administrative support. SIGs are intended:

- to facilitate the development of new consortia and partnerships;
- to facilitate technology transfer, by putting technology consumers in touch with technology providers;
- to articulate a long-term vision of where the sub-field is going, identify key technology gaps in that sub-field, and highlight possible routes of attach for these technology gaps;
- to develop the technological roadmap for AgentLink.

Five SIGs have been established as in AgentLink II as continuations of SIGs from AgentLink

- SIG01: Agent-mediated electronic commerce
- SIG02: Methodologies and software engineering for agent systems
- SIG03: Intelligent information agents
- SIG04: Agent-based social simulation
- SIG05: Intelligent agents for telecommunications applications and telematics

These SIGs, which were established by a process of reviewed applications in AgentLink, meet to discuss key issues.

SIG01: Agent-mediated electronic commerce

The Internet is spawning many new markets and Electronic Commerce is changing many market conventions. Old commercial practices are being adapted to the new conditions of immediacy brought forth by the global networks, and new products, services, as well as new practices, are beginning to appear. Agent-based technologies are crucial for these developments.

However many theoretical, technological, sociological and legal aspects will need to be addressed before such opportunities become a significant reality. This Special Interest Group serves as a platform to promote the interchange of ideas among specialists to stimulate and facilitate a significant European contribution to the field. This SIG aims to serve as a platform to permit the dialogue between academic partners and practitioners from industry. It will help in promoting the generation of strong consortia that participate in the programmes of the European Commission by focusing on those areas of Electronic Commerce that involve the development and use of agents and agent-mediated interactions including:

- Agent design for electronic auctions and electronic institutions,
- Electronic Market Places as agent societies,
- Negotiation strategies for agents,
- Agent-mediated retailing,
- Coalition formation,
- Trusted third parties,
- Agent standards,
- Agent-mediated interaction with public administrations.

Expected Results

The objective of this SIG is to establish a channel of communication between the researchers and developers interested in the area of agent-mediated electronic commerce in Europe. The channel of communication is twofold: physical and virtual.

The physical channel consists of 1 or 2 meetings per year, partly funded by AgentLink, in which a basic agenda is agreed upon and followed by all participants. Of special interest in these meetings will be the presentation of new products and the presentation of successful applications of agent-mediated electronic institutions, but theoretical contributions as well as the examination of legal and business practices should also be a constitutive part of the agenda.

The virtual channel is through web pages and mailing lists to facilitate the exchange of ideas and the collaboration among AgentLink members.

SIG01: First report, Amsterdam, 22-23 February 2001

The objective of this meeting was twofold. We wanted to present and discuss some new results and ideas of the participants, and to plan the AMEC activities within AgentLink II. For the first objective a series of 20 minute presentations were scheduled. Also, and given that the meeting was short and that we wanted to schedule a time slot to meet together with the ABSS SIG participants, we decided to kill two birds with one stone. We organized the common meeting as a panel to discuss a common focus of attention: “Electronic Institutions”, where the different views on the topic were lively (and friendly). For the second, an open discussion was held and some action lines agreed upon. They are summarized at the end of this short note.

The coordinator presented the book “Agent Mediated Electronic Commerce – The European AgentLink Perspective”, Lecture Notes in Artificial Intelligence 1991. It contains the contributions gathered during the three meetings held by the SIG during the life span of AgentLink I. This was the main outcome of the previous work done within the SIG and contained the first technological roadmap developed with contributions coming from all AMEC participants.

There were 24 attendants in total. Eight participants were from industry and twelve from academia. Only 10 asked for support from AgentLink. This is a positive element showing the interest in the topic addressed by this SIG although the industrial participation should be encouraged for future meetings.

Presentations and panel

Andrew Byde, from HP Labs, talked about the use of reinforcement learning techniques in agents participating in multiple Dutch auctions, a very hot topic. Ana Paula Rocha presented the latest proposals from the Porto group referring to the use of negotiation models and their relation with Electronic Institutions and Virtual Enterprises. She also used notions of reinforcement learning in her model. Ulises Cortés, from UPC, presented an application of the Electronic Institution concept to the problem of human tissues distribution for transplantation. On the more theoretical side, Alessio Lomuscio, from Imperial College, sketched some ideas in the direction of the formalization of one of the cornerstones of Electronic Institutions: the notion of obligation. He gave semantics that would permit to reason about the violation of norms and obligations in Multi-Agent Systems.

Rachel Bourne, from QMW, gave a paper describing her group's ideas on market infrastructures for real-time trading. Their decentralized approach aims at being an alternative to traditional auction markets. The project EIComAg was introduced by Mihail Matskin, from NUST. It also focuses on the deployment of infrastructures for electronic marketplaces, including a very interesting application to knowledge trade. The notion of brokering centered Mehdi Dastani's presentation, who represented the VUA group.

Finally, on the front of personalization, Josep Lluís de la Rosa, from the University of Girona, presented some promising ideas imported from the area of automatic control to model the learning of user profiles.

The panel organized in cooperation with the ABSS SIG showed many shared views in the design of agent societies. More shared views than expected! The presentation of the UK deregulated power market by John Chennells from Logica was very clarifying and showed in detail how complex the institutions and agent organizations to be developed to cope with real problems may be. The participants in the panel were: John Chennells, Frank Dignum, Scott Moss, Eugenio Oliveira, Julian Padget and Carles Sierra.

Next actions

With respect to the structure of the three meetings to held during AgentLink II several ideas were proposed:

i) to prepare the edition of a handbook on Agent Mediated Electronic Commerce, or on some relevant subtopic, for instance, 'Negotiation',

ii) to discuss the situation of agent technology at different companies; the companies may come and explain what they use and why they use it, and then the AMEC participants could give feed back to them,

iii) to have small discussion groups working (maybe) in the direction of preparing specific handbooks.

iv) to work on newer versions of the technological roadmap.

No need to say that most participants still want to listen to the newest results of the different groups, so some time should always be scheduled for this purpose. After listening to the opinions of the participants, action ii) seems the most interesting for the next meeting in Prague this July.

Analysis

AMEC can play a useful role within AgentLink. It keeps a high cohesion of the topics and interests of the participants, and most participants find it useful to attend. We have to be careful in not creating too high expectations with respect to the outcome, though. We don't have to forget that the activities funded by AgentLink cover just the meeting expenses of a subgroup of participants.

The most negative aspect (not extremely negative in my opinion) is about the industrial interest. Although we had 33% participation from industry in this meeting we still have to increase it.

SIG02: Methodologies and software engineering for agent systems (MSEAS)

The basic principles and lessons of software, knowledge, and distributed systems engineering, as well as the same scientific rigour pervading these research areas, have to be applied to the development and deployment of multi-agent systems.

At present, the majority of existing agent applications are developed in an ad hoc fashion: little or no rigorous design methodology, limited specification of the requirements, ad-hoc design of agents and of multi-agent system as a whole, and little attention to non-functional requirements such as mobility, scalability, performance issues, standards. This is indeed a limitation for the widespread appliance of any new software technology. And, of course, it can be a strong limitation for agent-based computing too.

Moreover, outside the agent community, there is still no widespread acceptance of agent-based computing as a new paradigm. Many people - both from academia and from industry - still think that agents are nothing but grown-up objects, re-newed with a nice, publication-appealing, name. Although the raising of some scepticism is intrinsic with the introduction of any new technology, we feel that this problem is actually exacerbated within the agent community by the lack of a clear and unambiguous terminology, of a clean set of abstractions, and, even more important, of a full understanding of the commonalties and differences between the agent paradigm and more traditional (i.e., object-based and component-based) paradigm for software development, and of the associated advantages and drawbacks.

Clarifying what makes agent-based approach to the development of complex software systems different from traditional component-based and object-based approaches, and developing a discipline of agent-oriented software development accordingly, are thus necessary goals to be achieved for making agents accepted outside the agent community.

Goals of the SIG

The Agentlink SIG on Methodologies and Software Engineering for Agent Systems (MSEAS) is meant to provide a European, multi-disciplinary forum for all researchers and practitioners who are interested in research and development of methodologies and software engineering for agent systems.

Any topic related to the engineering of agent systems and to the associated methodologies if of interests to the SIG. These include, among the others:

- identification of suitable abstractions and ontologies for agent systems;
- analysis, design, and testing techniques for agent systems;
- formal techniques for specification, design, and verification;
- methodologies for the development of agent systems;
- development tools and infrastructures;
- standardisation issues;
- non-functional requirements, e.g., performance, mobility, distribution, and reliability;
- analysis of relations with traditional software engineering approaches.

The SIG brings together a sub-community of AgentLink interested in the above topics, and, due to its intrinsic inter-disciplinarity, intends to promote strong interactions with all the other AgentLink SIGs. This can facilitate inter-SIG exchange of ideas and cooperation, as well as the development of co-ordinated research projects.

In addition, the SIG intends to put a strong emphasis on practical use in industry, by involving in its meetings researchers and practitioners from European industries. Last but not least, the SIG will try to maintain strict contacts with those consortia that are currently working in similar areas (e.g., OMG and FIPA), so as to promote cooperative standardisation actions.

It is expected that the SIG, during its activity, will be able to define a clear roadmap of both long-term and short-term research activities in the area, and it is hoped that the activities of the SIG will increase the European influence in the area.

SIG02: First Meeting, Prague, 9-11 July, 2001

The MSEAS SIG has been active for the two first years of Agentlink I, under the excellent coordination of Jan Treur. The recent appointment of Franco Zambonelli as the new coordinator of the SIG in Agentlink II came with the responsibility of giving new life to the SIG and of re-starting its activities. Accordingly, the first meeting of the renewed MSEAS SIG held in Prague on July 9-11 2001, had the primary goal of re-vitalising the SIG and, by building on the past activities of the SIG itself, of delineating its future activities and working directions.

The activity of the MSEAS SIG during the meeting alternated public and private working sessions. Public sessions were intended to investigate and discuss issues related to agent-oriented software engineering via focused presentations of state-of-the-art approaches and proposals, and via panel discussions. Working sessions were intended to identify technological roadmaps, discuss about research proposals, and foster relationships between partners in academia and industry.

It is also worth mentioning that the MSEAS SIG - as a further related activity - actively participated in both the organisation and the work of the 2nd International Workshop "Engineering Societies in the Agents' World", which located its successful 2001 edition in Prague, two days before the start of the SIG activities.

Before the meeting, and during the organisation of public sessions, discussions with other SIG and WG coordinators made it clear that inter-SIG sessions, analysing specific agent topics and applications from a software engineering perspective, could be fruitful and cross-fertilising. In addition, during the organisational work, it was possible to keep in touch with several individuals and research groups, even outside Europe and Agentlink, interested in the activities of the SIG, which enabled the identification of the urge, within the SIG, for a Working Group specifically focussed on Methodologies. Federico Bergenti (University of Parma) and Carlos Iglesias (University of Madrid) agreed to cooperatively take care of this working group and to organise a public session on Methodologies.

Public Sessions

Three public sessions took place in Prague:

- Mobile Agents and Software Engineering, co-organised by Volker Roth (co-ordinator of the SIGMA SIG) and Franco Zambonelli;
- Coordination and Software Architectures, co-organised by Paolo Petta (co-ordinator of the Communication, Collaboration and Coordination Working Group of the I2A SIG) and Franco Zambonelli;
- Methodologies and Tools for Software Engineering, organised by the MSEAS Working Group on Methodologies.

For all the sessions, talks presented by academic speakers were interleaved by talks by industrial speakers. The slides for most talks are available on the SIG web site (http://polaris.ing.unimo.it/MSEAS). Overall, there were an average of 6 talks per sessions and of 30 participant to each session.

During the session on mobile agents, several interesting talks were presented, showing the strict relations between agent mobility and the problem of effectively engineering distributed agent systems. Gian Pietro Picco (Politecnico di Milano) did very good work in identifying the false myths about mobile agents, and in clearly analysing the extent to which agent mobility can be effectively exploited in distributed agent systems. Luc Moreau (University of Southamptom) discussed several issues related to the infrastructures and the algorithms needed to allow two agents to effectively communicate with each other while moving in a wide-area network. Walter Binder (CoCo Software Engineering, Austria) presented the approach adopted in the J-Seal system to improve security and resource control on agent systems. Christophe Sibertin Blanc (Universitè de Toulose, France) discussed the approach that his research group has adopted to automatically derive implementation of mobile agent classes from declarative specification. Finally, Alex Poylisher (University of Warwick) discussed the problem of achieving load balancing of distributed resources via agent mobility. The presentations raised an interesting discussion, focused on the problem of analysing the trade-offs between the need for agents to communicate with each other and the need for agents to move in a network, the latter making communications more difficult.

The session on Coordination and Software Architecture focused on the problem of analysing the issues related to the definition of suitable coordination models and architectures for the development of complex agent systems, and of the corresponding infrastructures. Andrea Omicini (University of Bologna) and Sasha Ossowski (University of Rey Juan Carlos, Madrid) co-presented an overview of the possible approaches that can be adopted in the definition of a coordination model for multi-agent system. In particular, they pointed out the differences between the "subjective" and the "objective" approaches to agent coordination. Stefan Bussmann (Daimler Chrysler, Germany) provided a very interesting industrial perspective on multi-agent systems coordination, showing how the adoption of agent-based systems and of a suitable coordination architecture can lead to dramatic improvements in the productivity of manufacturing control systems. Paolo Busetta (IRST, Trento) presented an overview of the agent research activities currently taking place at IRST, and discussed how the research on multi-agent coordination and communication plays a primary role. Christophe Sibertin-Blanc (Universitè de Toulose, France) discussed the problem of electing agent interaction protocols to a first-class abstraction in the design and development of multi-agent systems. In addition, Karin Anna Hummel (University of Vienna) critically analysed the possible approaches to agent coordination in the presence of mobility, with a particular focus on fault tolerance. The discussion following the talks has identified the need for suitable coordination models and infrastructures, facilitating the development of complex multi-agent systems. In particular, as the complexity of software systems is always increasing, and as these systems usually gets immersed in a dynamic environment, the discussion pointed out the need for new coordination models and tools, suitable to identify and control the emergence of dynamic and non-programmed behaviours in distributed multi-agent systems.

The talks presented during the session on methodologies were mainly devoted to describing different analysis and design methodologies, as well as different development tools, developed in different research groups. Paul Kearney (BTexact Labs) provided a complete overview of the methodology for the analysis and development of agent systems defined in the context of the MESSAGE European project. Marie-Pierre Gleizes (IRIT, Universitè de Toulose) discussed the approach they are going to adopt in the definition of a new methodology for adaptive agent systems. Anthony Karageorgos (Department of Computation, UMIST) presented a different methodology, mainly based on the abstraction of agent roles. Marie-Pierre Gervais (Lip6, Paris) presented an overview of the ODAC methodology, recently defined in her research group. Federico Bergenti (University of Parma) presented the ParADE toolkit for interoperable (i.e., FIPA-based) Java agent systems. Finally, Carlos Iglesias (University of Madrid, Spain) presented the JAEN development environment. The very different approaches adopted by different methodologies and tools, as well as the different terminology adopted by different research groups, pointed out the need to discuss, during the private working sessions, the possibility of agreeing on a common terminology in agent-oriented software engineering and for an in-depth comparison of the presented methodologies.

Working Sessions

The private sessions of the SIG, following the public ones, were of a working nature.

At the beginning of the first session, a round of self-introductions allowed the identification of both the research activities currently taking place in the research groups of the participants and the directions that these research activities are going to take in the near future. In addition, participants were asked to express their personal visions on the long-term future of agent-oriented software engineering and their opinion on what could be the hot-topics for research in the short term. This round of presentations not only allowed people to familiarise themselves with each other in a quick way, but made several discussions arise, during which several important research issues were identified.

With regard to the short-term future:

- most of the participants feel the urge for defining a sort of ontology for agent-oriented software engineering, providing an essential, unambiguous, and commonly adopted set of terms for the research in the area;
- in particular, the need for strictly relating and comparing the terminology adopted in mainstream (e.g., object-based and component-based) software engineering with the one adopted in the agent community was also pointed out;
- a result of the above work could be a better understanding of the commonalties and differences in the wide variety of approaches to agent-oriented software engineering and, consequently, a faster advance of the research activities in the area.

With regard to the long-term future:

- it is quite a common feeling that research on the engineering of complex agent-based systems may have a strong impact on the definition and implementation of the middleware for distributed, embedded, and mobile applications;
- several of the participants think that more and more research related to the engineering of complex software systems have to start learning the lessons of those research areas that traditionally deal with the understanding of complex systems, such as biology, sociology, and thermodynamics.

As a result of the discussions, the participants agreed that the MSEAS SIG could have been a very good forum for attempting to define a common ontology. Then, we decided to involve all the participants in a brainstorming session, aimed at starting identifying all the terms that we, as researchers, currently adopt in our work on agent-based software engineering. Overall, more than 60 terms came out from the brainstorming, some of which turned out to have completely different meaning for different people, and others turning out to have several synonyms. This confirmed to us the need for working towards a common ontology, and we all agreed to continue the work beyond the meeting.

At the end of the meeting, the SIG and WG coordinators defined a schedule for the definition of the first draft of a roadmap paper, and asked all the participants to actively cooperate in the definition of such a roadmap.

Of course, since all the activity that the MSEAS SIG has decided to undertake is of a very inter-disciplinary nature, it was agreed by all the participants that, even for future meeting, it will be useful to continue co-organising sessions with other SIGs, to promote exchange of ideas and discussions.

Future Activities of the SIG

The first meeting of the MSEAS SIG was very fruitful, in that it enabled the establishment of strict working relations among the members of the SIG, and enabled the definition of the working activities of the SIG until the next meeting. These activities, related to the definition of a common ontology to the cooperative writing of the first draft version of a roadmap of agent-oriented software engineering research, will take place via mailing list discussions.

In the future, the MSEAS SIG will continue to work on the roadmap and on the common ontology, and to focus on hot-topic research issues in the area. In particular, it is expected that topics such as formal models, verification techniques, and testing techniques, not properly addressed in the Prague meeting, will find adequate room for discussions. To this end, those interested in specific software engineering issues are invited to participate actively

participating in the SIG activities, also via the creation of specific working groups, in addition to the methodologies working group.

As a final note, although the industrial participation to the first meeting of the SIG was quite satisfactory, the activities of the SIG are expected to be able to attract even more people from European industries and to effectively promote cooperation between industry and academia.

SIG03: Intelligent information agents (I2A)

The research and application area of intelligent information agents is of rapidly increasing importance. Information agents are computational software systems that have access to multiple, heterogeneous and geographically distributed information sources as in the Internet or corporate Intranets. The main task of information agents is to perform active searches for relevant information in non-local domains on behalf of their users or other agents. This includes retrieving, analyzing, manipulating, and integrating information available from multiple autonomous information sources.

Intelligent information agents have to face up to the increasing complexity of modern information environments, ranging from relatively simple in-house information systems, through large-scale multidatabase systems, to the visionary Infosphere ('Cyberspace') in the Internet. Intelligent information agents may have different characteristics dependent on the concrete application domain; they may behave adaptive, self-interested rational, cooperative, or are even mobile. Thus, research on, and development of, fielded systems of information agents in the Internet is a challenging task, and is crucial for the development of next generation open information environments.

This Special Interest Group on Intelligent Information Agents will serve as a platform to promote the interchange of ideas among interested people, research groups, and projects to stimulate and facilitate a significant European contribution to the field. This concerns, in particular, researchers from the following areas:

- Database and Information Systems
- Information Retrieval
- Artificial Intelligence
- CSCW (Computer Supported Collaborative Work)
- HCI (Human Computer Interaction), HAI (Human Agent Interaction)

The SIG strongly encourages and supports activities and collaborations among academic and industrial partners. This includes, e.g., the dissemination of relevant information, regular SIG meetings, and support of related conferences.

SIG03: First Meeting, Amsterdam, 22-23 February, 2001

The fifth meeting of the I2A SIG was held at the University of Amsterdam, Roeterseiland Complex, The Netherlands. The purpose of this two-day meeting was four-fold.

1. Update of latest activities and achievements by SIG members in the I2A domain in Europe.
2. Establishment of a new working group on Adaptive Information Agents (AIA WG) chaired by Pete Edwards (University of Aberdeen, UK).
3. Brief discussion about future activities of the SIG in Agentlink II until 2003 including the re-organization of the ADK working group.

4. Foster relationships to and proceed joint work with members of the SIG and their partners in academia, industry, and standardization organizations.

An average of 22 registered participants attended this SIG meeting.

Presentations

The first day of the meeting was organized as an AgentLink II plenary day offering the attendants a fine sequence of invited talks as well as a highly interesting and controversial panel discussion on the status and future opportunities for collaboration between the AgentLink network for agent-based computing and industry in Europe. Each of the coordinators of the currently active AgentLink SIGs gave a brief summary report on past achievements and an outline on future activities. The second day of the first AgentLink II meeting was devoted to the special SIG meeting sessions. Regarding the I2A SIG meeting it started off in the morning with three invited talks on discussion inspiring topics all attendants. First, Bernhard Bauer from Siemens AG, Germany, briefly sketched his subjective view on the status and challenges for the I2A SIG; then Stefan Kirn (TU Ilmenau, Germany) presented the scope, status, and perspectives of collaboration for the SIG with project partners in the German research program on agents for economic applications; finally, Michel Klein (VU Amsterdam, The Netherlands) gave a brief status report on European developments around the Semantic Web (OntoWeb, DAML+OIL, etc.). The latter talk provided the participants of the SIG meeting with first-hand insights to ongoing work and recent achievements in this exciting domain which is highly influencing the development and deployment of information agents in the next generation of the worldwide Web.

In the afternoon both working groups of the I2A SIG then broke out to hold their individual meeting with reports on current and future work in parallel sessions. The working group AIA on adaptive information agents with a focus on personalisation strategies had its kick-off meeting chaired by Pete Edwards. The brief reports from initial group members had topics according to the focus of the group: Liliana Ardissono (Uni Torino, Italy) reported on personalization strategies for an adaptive web-based system developed in her research group; Ramon Sanguesa (Uni Politechnica de Catalunya, Spain) summarized the architecture and results of the I2CAT project on agents for collaborative support; Ian Dickinson from HP Labs in Bristol, UK, discussed issues and opportunities of how to disaggregate personal profiles; finally, Marten van Someren (SWI Amsterdam, The Netherlands) encouraged the working group to foster the existing connection to the machine learning community in his talk on deployment of ML techniques within agents. The presentations were followed by a discussion on the roadmap of this working group for the upcoming years; especially the exploration of links with MLNet (European Network of Excellence in Machine Learning), and EUNITE (European Network of Excellence on Intelligent Technologies for Smart Adaptive Systems) is on its way. The AIA working group's Web page includes more details on their activities at http://www.csd.abdn.ac.uk/~pedwards/AIA/. The C3 working group chaired by Paolo Petta (AIAI Vienna, Austria) met for the first time again since autumn 1999 to synchronize potential collaborations between its members who stayed active in the meantime. Brief presentations were given by Christophe Sibertin-Blanc from Uni Toulouse, France, on the need for a technology of interaction protocols, by Andrea Omicini (Uni Bologna, Italy) on coordination services for agent infrastructures as well as people by Rune Gustavsson (Blekinge Institute of Technology, Sweden) on the provocative question "who wants agents?" with subjective perspective on and respective proposal for a R&D agenda based on societal needs with focus on eHome, eHealth, and support for caretaking for handicapped people. As usual, presentations made available by the authors are accessible for SIG members in the BSCW (http://bscw.gmd.de/bscw/bscw.cgi/0/7723938). The slides of the summary report on the I2A SIG in AgentLink 1 are also available on the SIG's Web page (see http://www.dfki.de/~klusch/i2aActiv.html - Amsterdam meeting).

Organizational Issues and Next Actions

Regarding the unbalanced nature of the numbers of participants from industry and academia at this particular meeting at the first time (20 from academia, 3 from industry) we certainly have to increase our efforts to improve this figure again. I am confident that we may return to

a reasonable balancing of participation soon after the new working group AIA has settled and the C3 working group completely recovered from the cancellation of the fourth SIG meeting in Saarbruecken. In fact, the unfortunate short-term cancellation of the last meeting in Saarbruecken a posteriori turned out to be partly harmful for the SIG as a whole, since it caused a sudden cut-off of many promising new but also established connections to interested parties from industry, and prevented synchronization and continuation of work in progress of both working groups (C3 and ADK) until this meeting in Amsterdam. In the meantime the major part of the most visible and productive ADK working group with focus on agent-based knowledge management then decided to help setting up and almost completely joining the European thematic network OntoWeb (www.ontoweb.org). Though latter fact may be considered as a success for the working group in particular and the I2A SIG in general it implied a serious discussion on the organisational shape and focus of activities of a new ADK working group. In this respect I am very grateful to Sonia Bergamaschi (Uni Modena, Italy) who volunteered to take the lead in the matter of re-organizing and chairing a ADK working group with new focus on agent-based information systems, intelligent information extraction and integration. Contacts to new industrial partners in the data mining domain have been initiated already. The kick-off of the reborn ADK working group will be at the next SIG meeting. I am also particularly indebted to Paolo Petta for his invaluable efforts in continuing to pursue the goals of the SIG's C3 working group especially during the long transition time from AgentLink 1 to AgentLink II without any funded meeting since Barcelona in autumn 1999.

SIG03: Second Meeting, Prague, 9-11 July, 2001

The sixth meeting of the I2A SIG was co-located with the third European Agent Systems Summer School (ACAI course on Multi-Agent Systems & Applications) at the Czech Technical University in Prague. The purpose of this meeting was four-fold;

1. Kick-off meeting of the re-organized working group on agent-based data and knowledge management (ADK).

2. Brief update on latest results in R&D of information agent technology in Europe by participants' presentations on selected topics.

3. Common session between the SIG's working group on coordination of information agents (C3) and the re-organized AgentLink SIG on methodologies for agent-oriented software engineering (MSEAS).

4. Foster relationships to and proceed with joint work among our partners in academia, industry and standardization organizations.

All working groups (C3, ADK, and AIA) of the SIG attended the meeting with an average and maximum of 17 and 25 participants per session, respectively.

Presentations

The first day started off with the ADK working group's morning session on information extraction and integration chaired by Sonia Bergamaschi (Uni Modena e Reggio Emilia, Italy) as chair of this working group, and Claudio Sartori (Uni Bologna, Italy). It discussed architectural issues for agents specialized in information integration, knowledge discovery and extraction in a networked environment with particular focus on agent-based data mining and mediator-based information systems. The first presentation of the session was given by Claudio Sartori on research challenges in the domain of information agents for data mining and distributed knowledge discovery. Alessandro Zanasi (IBM Bologna KDD Center, Italy) reported on the proprietary Online Mines system developed at IBM for agent-based text mining in the Web. Michel Klein (VU Amsterdam, Netherlands) provided us in his talk with very useful insights in and latest news about activities related to European developments around the Semantic Web including relevant projects such as OntoWeb and WonderWeb. The I2A SIG started to initiate and foster mutually beneficial collaboration with OntoWeb. In her talk, replacing the one of Maurizio Lenzerini who could not attend, Sonia Bergamaschi not

only gave a remarkable concise overview on systems for intelligent information integration with particular focus on their mediator-wrapper based system architecture and functionality, but also pointed out that the effective usage of description logics for representing and fusing heterogeneous knowledge sources in these systems preceded that in the recent Semantic Web initiative for years. In the afternoon session of the ADK working group participants briefly reported on research interests, current and past achievements in terms of projects of their organisation or institute.

The second day of the I2A SIG meeting was devoted to the joint session of the SIG's working group C3 and the MSEAS SIG on coordination and software architectures for agent systems, chaired by Paolo Petta (C3 WG chair; AIAI Vienna, Austria) and Franco Zambonelli (MSEAS SIG coordinator; Uni Modena e Reggio Emilia, Italy). Software architectures play a central role in the effective design and development of complex component-based systems. Coordination models and languages have the potentials to play an analogous role in the design and development of agent systems, by providing a range of means to flexibly structure agent organization and by providing the needed separation of concerns between intra-agent and inter-agent (organizational) issues, both during design and at run-time. The goal of the joint session in the morning was to analyse the current state of the art in coordination models and systems, and to relate it to MAS infrastructure inventory, pointing out similarities and differences between the "traditional" software architecture approach and the agent-based coordination approach. As a good introductory talk in this direction Andrea Omicini (Uni Bologna, Italy) and Sascha Ossowski (Uni Rey Juan Carlos Madrid, Spain) presented and discussed issues of objective vs. subjective coordination in the engineering of agent systems. Christoph Sibertin-Blanc (Uni Toulouse, France) described his view on protocols as first-class components in multi-agent systems based on the theory of cooperative objects in Petri nets. Enrico Blanzieri then briefly sketched the activities in application of agent technology in different domains at IRST (SRA division of ITC at IRST) in Trento. Stefan Bussmann (DaimlerChrysler Research Berlin, Germany) presented recent activities and projects at DaimlerChrysler concerning the application of multi-agent systems for production control. Finally, Karin Anna Hummel (Uni Vienna, Austria) introduced and discussed engineering issues (e.g., fault hypothesis, error detection and tolerance mechanisms), attributes (e.g., availability, reliability, security) and impairments (e.g., fault/error, integrity, communication with roaming partners) of dependability among mobile agents with focus on dependable communication.

The afternoon session was mainly devoted to identify the common ground for further collaboration between both groups in short-, mid-, and long-term perspective. However, after the introduction of each of the attendees with focus on past achievements and personal scientific desiderata a large part of the time devoted for the discussion has been spent on (re-) clarifying the differences and commonalities in topics between both groups. Finally, a preliminary agreement has been achieved in that both groups may have a mutual benefit from the creation of a "standard" ontology (glossary) of notions and prevalent techniques in the domain of the MSEAS SIG. The C3 working group will contribute to this ontology from their domain-specific perspective such as notions and techniques for coordination and collaboration between information agents such as matchmaking, brokering, mediation, and others. On the other hand, easy-to-use methodologies and toolkits to develop reliable multi-agent systems in a composite and/or plug-in fashion are of inherent interest for the I2A SIG, in particular the C3 working group to provide input to the ADK working group concerning coordination (agent) modules for building agent-based systems for data and knowledge management. In return, the practical issues that are due to the building of such systems may be of value for the MSEAS SIG especially considering the state-of-the-art of approaches and methodologies for agent system development.

On the last day people of the working group on adaptive information agents (AIA) jointly met in the morning for reporting on their recent activities and achievements. The half-day session commenced with an overview presentation from the working group chair (Pete Edwards, University of Aberdeen) on recommender system technologies as one type of adaptive information agent. The different categories of recommender systems (content-based, collaborative, hybrid) were described and a number of recent European activities highlighted. The talk ended with a number of research issues and challenges, including: user-profile

representation, privacy, strategies for user-feedback, the importance of evaluation of RS technologies. A series of three AgentLink II node activity reports formed the next segment of the programme. The first report (Enrico Blanzieri, Universita di Torino/ITC-IRST) presented a model which allows an agent to acquire knowledge of the "implicit cultural context" within which a group of agents are operating, and thus to behave in a manner consistent with that of the larger community. The next speaker (Josep Luis De La Rosa i Esteva) was unable to give his presentation on "Physical Agents, CBR and Personalisation" due to illness. The final activity report (Claire Green, University of Aberdeen) discussed how clustering methods could be employed within a recommender system architecture; she described how such techniques could be exploited to limit the amount of direct user feedback required when learning a user's movie preferences.

Research on adaptive technologies for agent-based profiling and personalisation cannot operate without an awareness of the social and legislative context, and the group held a panel discussion on the issues surrounding "Agents, Profiling & Privacy". A number of panelists presented differing views and there followed a lively debate. One panelist noted that users are willing to share data if they perceive it as being in their interest, i.e. they benefit in some way. Such a cost/benefit trade-off lies at the heart of the personalisation and privacy debate. The W3C P3P standard was criticised by another panel member as being too supplier-oriented; if a user doesn't accept a site's privacy policy will a lower level of service be offered? Distributed vs. centralised approaches to profile management were contrasted, as a way of giving users more control over their personal data. How should an agent-based approach to personalisation balance the goals of the user vs. the goals of an enterprise? A key theme to emerge from the discussion session was the need for agent-based solutions to consider the needs of users, and to look beyond purely technical solutions.

Organisational Issues

The AgentLink II management committee approved my proposal that Sonia Bergamaschi becomes also a co-coordinator of the I2A SIG and welcomed her involvement. Furthermore, Pete Edwards, currently chairing the SIG's working group AIA on adaptive information agents, will be strongly involved in the establishment of an inter-network SIG in the general domain of learning agents and multi-agent systems with support by Daniel Kudenko and others. Pete Edwards has been assigned to co-ordinate this new SIG in case of its successful establishment, which in turn implies that we have to decide on a new chair of the AIA WG of the I2A SIG. It has been agreed upon at the meeting that this working group should continue to focus on personalization techniques in the domain of information agents and systems since it shows large potential of industry-oriented applications. This in turn may increase the number of industrial partners participating in the SIG.

In addition, it has been agreed upon that upcoming I2A SIG meetings should (again, like the first ones) try to have a more or less general theme to which each of the SIG's working groups may productively contribute from the perspective of their domain in general and actual "home work" in particular. This is also in order to avoid harmful diversification of participation during the meeting as we have experienced it this time to some extent; all participants are encouraged to attend every session rather than just the one of the working group they are currently participating in. However, the change in duration of the meeting from one or two days to full three days was identified by many attendants as to be a major hurdle for attending the complete SIG meeting. The planning of the next SIG meeting will try to take all of these considerations into account.

Next Actions

The immediate action to take by the co-coordinators concerns the SIG's roadmap for AgentLink II; in this context, it is planned to review the activities of participatants in the SIG including update of research statements published on the SIG's Web page, and to further improve participation of industrial nodes.

In addition, based upon the brief discussion during the meeting on the motivation and planned structure of the book "Information Agents Research and Development in Europe – An

Agentlink Perspective", we are currently seeking high-quality contributions from each of the SIG's working groups on recent advances in R&D (industrial, academic) in the respective domains of information agent technology. This book will be probably published by Springer as an LNCS State-of-the Art-Survey; we are aiming for publication at the beginning of next year. Proposals for contributions (name, affiliation, AgentLink II node, WG, title, abstract) should be sent as soon as possible to the chair of the respective working group, that is Pete Edwards (AIA; pedwards@csd.abdn.ac.uk), Paolo Petta (C3; paolo@ai.univie.ac.at), and Sonia Bergamaschi (ADK; sonia.bergamaschi@unimo.it).

For further information on the activities of the I2A SIG please contact Matthias Klusch (klusch@dfki.de) or Sonia Bergamaschi (sonia.bergamaschi@unimo.it).

SIG04: Agent-based social simulation (ABSS)

Computer simulation has proved useful for modelling phenomena of traditionally social scientific interest, such as cooperation, coordination, organizational behaviour, social dynamics, group and coalition formation, and the evolution of conventions and norms. Multi-agent researchers soon came to realize how crucial these topics are within their field. In particular, the study of emergence of social phenomena such as organizational performance and optimisation, cultural norms, institutional forms has become a major direction of research in MAS. In turn, such social modelling rings into play a variety of normative concepts, such as conventions and obligations, and phenomena, such as commitment and responsibility, and draws attention to how these phenomena evolve among computational agents in interaction. These concerns have led social simulators to pay increasing attention to agent modelling. Dissatisfied with the model of the rational social actor, they have developed simulation models of evolutionary social phenomena incorporating representations of cognition derived other disciplines such as cognitive science and social psychology. However, the model of the agent used is essentially behavioural and frequently more rudimentary than those developed in some areas of AI.

The computational study of social organizations and institutions is a topic of growing interest in both the computer science and social science communities. In the formal/computational scientific communities, logical philosophy and social philosophy have a long tradition in studying institutions and obligations. Interest in such issues is rapidly growing. This is shown by several indicators, including (a) the number of workshops, etc.; (b) the diffusion of notions of obligation, convention, trust, commitment, reciprocity, right, permission, etc. in the research on intelligent agents; (c) the attention paid to norm-based phenomena in designing and implementing situated intelligent agents (consider the trade-off between robust performances and flexibility: formal and computational research on commitment essentially proceeds from the question of how to design intelligent, adaptive, flexible agents that exhibit robust performances; moreover, think of the research on conventions as solutions to problems of coordination among autonomously interacting agents).

Interestingly, the more the MAS researchers pay attention to evolutionary and dynamic organizations and institutions, the more they use computer simulation (for example, simulation-based studies on the evolution of conventions, commitment, altruism, in MAS, and the role of simulation in the study of organizations). Where the social sciences meet the physical and biological sciences as, for example, in the modelling of climate change, there is growing disenchantment with analytic equilibrium approaches to analysis of social and economic systems. Agent-based simulation methods are proving attractive to physical scientists seeking to take socio-economic factors into account in the analysis of such issues. Increasingly, we are seeing agent-based social simulation used to provide more realistic alternatives to analyses of the whole area of exchange with particular success in generating empirically more satisfactory models of financial markets.

Within the AgentLink framework, these various communities are given the opportunity to meet and discuss matters related to the theme proposed. The theme is transverse to several pure and applied research fields:

- electronic commerce, trading relationships

- intelligent information agents
- robotics
- organizational structure and change
- authorization
- delegation
- social and collective action
- commitment
- reciprocity and cooperation
- institutions, empowerment, and roles
- coordination and conventions
- autonomous social agents modelling

An issue exercising the social simulation community is that of emergence which has important implications for all of the above areas.

SIG04: First Meeting, Amsterdam, 22-23 February, 2001

The ABSS SIG under AgentLink 1 explored the range of research activities conducted in Europe under the broad rubrics of agent based social simulation and multi agent based simulation. An important and lasting consequence of the ABSS SIG under AgentLink 1 was the development of communities of interest among SIG participants who had different objectives in ABSS and MABS and came from different backgrounds in computer science, social science and philosophy.

Although a new research area, there has been a vibrant and successful social simulation community in Europe for some years. Milestones in the development of this community are the edited books resulting from a series of workshops and conferences in the 1990s. There has also been a distinct development within the computer science part of the MAS community towards viewing and using MABS as general simulation paradigm. There have certainly been important overlaps, as demonstrated for example by the invited papers of Doran and Carley at ICMAS-98, the ABSS SIG provided a new focus for the joint development of MABS as computer science and as social science. In addition, there have been developments that have proved stimulating to both social scientists and computer scientists working on agents research. Obvious examples are the work by Castelfranchi, Conte and their colleagues at CNR-IP in Rome.

An important result of the AgentLink 1 SIG was the clear identification and distinction between foundational and representational ABSS. Foundational ABSS is largely formal and is intended to provide a basis for a new social theory, though no such theory has yet been realised. Representational ABSS describes real social systems as a basis for analysing the reasons for the emergence of epiphenomena at macro system scale as a consequence of the behaviour of agents and the interactions among them. One objective adopted by the SIG was to investigate whether the formal approaches of foundational ABSS could usefully inform and support representational simulation.

The point of bringing these two branches of ABSS together is not entirely to develop new theory or methodology. It is a part of a wider research programme to develop scalable multi agent systems with direct applications. At the Amsterdam SIG meeting in February 2001, a dominating subject of discussion was whether and how ABSS could provide guidance and

insight into the achievement of multi agent systems for very large scale applications in complex environments. A particular issue was whether the social simulation techniques developed to describe actual, large scale, complex social systems could provide the appropriate metaphors for large scale, complex software systems. It was agreed at the Amsterdam meeting that one objective of the SIG under AgentLink II will be to identify and develop such synergies between the designing and engineering of agent based software systems on the one hand and, on the other hand, agent based social simulation.

A second issue of concern is the lack of involvement in the SIG under AgentLink 1 by industrial, commercial or policy interests. Such involvement is a key element in the justification of the SIG since a primary purpose of AgentLink (both 1 and 2) is to bring together the needs of the industry and (in our case) the policy communities with the capabilities of the academic community. In the particular case of the ABSS SIG, it is essential to involve both the foundational and representational interests of the academic research community in order to assess without preconceptions how ABSS can usefully and uniquely inform and support the design and engineering of practical multi agent systems.

Below, we will first describe the working group established at the Amsterdam meeting to meet the above criteria and then, how this working group might be used as a pattern for the establishment of further working groups. This report concludes with a brief discussion of the implications of the Amsterdam discussions for MAS research more generally.

Working group on scalable MAS for dynamic environments

The specific objectives of this working group are to identify and demonstrate the features of MAS

- that are scalable where the properties of the software environment emerge from agent behaviour and interaction

- that enables dynamic "plug-and-play" functionality based on social principles in addition to, or if possible rather than, standardised ontologies and protocols.

It was agreed that a suitable demonstrator system should be developed around a design problem described by André Meyer and Joost Reuzel from Philips Research in Eindhoven. The problem is the following: Philips wants to develop cooperating, intelligent consumer appliances that interact with each other and humans to provide the latter with desired services. Some simple examples include

- a follow-me concept which divorces activities from devices. For example, if a person is watching television and moves to another room with another television (say the kitchen to make a cup of coffee), the second television will display the same programme.

- A multi-user, multi-device, multi-location design so that, if a person enters a room with both a television and a stereo system and is “known” by both to want some form of entertainment at that time and in the existing circumstances, the television and stereo agents will negotiate between themselves to provide the most appropriate service – television or music.

- Dummy-proof network installation and administration so that when a new appliance is introduced into the house, it will integrate itself into the domestic network without human intervention.

Taken by themselves, these are fairly standard AI issues. Each appliance is controlled by a software agent that learns over time about the preferences of the humans with whom it interacts. Each appliance agent must learn to communicate with the other agents, perhaps to be informed by them of the humans’ preferences and to engage in such negotiation procedures as may be required with the other agents.

The intention for the working group is to identify an appropriate social metaphor to guide the agent and mechanism design process and to consider alternative approaches to the engineering of the proposed software, as well as understand and model the human context: norms, beliefs, reputation, policies, etc.

In the discussions in Amsterdam, a “playground” metaphor was discussed. The appliance agents interact in the “playground”, developing their own means of interacting much as children learn to play together. Although there is some base, standard communication language among agents, this is intended to be dynamic and evolving, just as children in playgrounds develop their own jargon and, at least as important, as a new child in the playground has to learn the social conventions and any special argot of the resident children.

In the sort of dynamic environment proposed by our colleagues from Philips Research, neither a static ontology nor a static protocol is obviously appropriate.

An important element in these discussions was the proposal by Frances Brazier and Niek Wijngaards of the Vrije Universiteit Amsterdam to use their AgentScape operating system which would include an agent factory and a facility for providing agents with additional elements of an interagent communication language (possibly with human intervention) as such elements became necessary.

A further concern was to maintain the input from the formal, foundationalist contributors to ABSS since the interactions between foundational and representational ABSS have been found in the past to be stimulating and productive. There is, moreover, a continuing interest on the part of the foundational ABSS community in investigating the utility of logical formalisms for the development of new social theory.

In order to pursue these concerns in a coherent fashion, it was agreed to establish the working group composed of (at least) Andre Meyer and Joost Reuzel (Philips Research Eindhoven), Frances Brazier and Niek Wijngaards (Intelligent Interactive Distributed Systems Group, Vrije Universiteit Amsterdam), Scott Moss (Centre for Policy modelling, Manchester Metropolitan University), Rosaria Conte and Mario Paolucci (CNR-IP), Magnus Boman (Swedish Institute of Computer Science), Harko Verhagen (Stockholm University/Royal Institute of Technology) and Paul Davidsson (Blekinge Institute of Technology). This working group is open to and welcomes any other ABSS SIG participants.

It is however important to point out that the purpose of the working group is not to undertake free industrial research for Philips or anyone else. The purpose is to use the Philips problem as a plausible and well-defined focus of discussion about the development of specific technical development that would support the use of social metaphor in the development of multi agent systems and the consequent development of techniques for analysing the sources of the social metaphors.

Further working groups

The contents of this section have not been discussed by the SIG and are therefore to be read as proposals by Scott Moss and Paul Davidsson as SIG co-ordinators.

It is neither expected nor desirable that the SIG should support only one working group. Members of the ABSS research community have a wide range of interests that should be served by appropriately focused working groups. The first ABSS working group should be seen as a point of departure. There should be some industrial involvement in any working group since a primary *raison d’être* of AgentLink is to bring industry and academics together. It is not necessary that there be a focusing industrial or policy application but, if there is not, there will need to be some clear focus to lend coherence to the discussions and developments by the group.

ABSS and MAS research more generally

Social systems evolve as a result of the behaviour of and interactions among the individuals of whom society is comprised. Invention and innovation are not imposed by any external force. Individual inventions and innovations typically result from the need to resolve some problem. The history of technology is replete with accounts of the new opportunities created by innovations that solve old problems. In the exploitation of those new opportunities, new problems are encountered that require new inventions and innovations with their consequent opportunities, and so on and on forever. The study of social systems is therefore the study of dynamic changing systems without crisp boundaries or clearly understood constraints.

If agent based computing is to be anything other than yet another programming paradigm with yet better modularity, encapsulation and reusability, it will be a result of its scalability, robustness in the face of uncertainty and its ability to respond to unforeseen environmental changes that the agents themselves may have brought about. The reason for having an Agent Based Social Simulation SIG in AgentLink can only be that it provides a means of capturing and formalising the essential aspects of dynamic, innovating, progressive social systems that operate at very large scale in order to build dynamic, progressive software systems that scale up as required.

SIG04: Second Meeting, Prague, 9-11 July, 2001

The meeting was divided into three sessions. The first session was dedicated to the working group on "Software Engineering for Highly Scaleable Software Agent Systems" and the second to a proposed working group on "Social Policy Analysis". The meeting was concluded by a session on the current and future focus of the ABSS SIG.

Session on Social Policy Analysis

The session was chaired by Nick Gotts from Macaulay Land Use Research Institute in Aberdeen. He and David Hales from the University of Essex kindly provided notes from this session upon which we have based our report. Nick made an introductory presentation, in which he set out some of the issues the working group might address. We will just include here the working definition of "social policy" that was used in the presentation: "A course of action adopted (usually by a governmental or political entity) with the primary aim of influencing mutual relations of individuals or groups." After this introduction, there were two parallel discussion groups, one focusing on possible application areas for the workgroup and ABSS and co-ordination / organisation of large-scale agent systems (containing many agents).

It was proposed that a goal for ABSS might be the production of a “cookbook” for the implementation of large scale MAS (those involving thousands of agents) co-ordination. It was commented that although this might be a laudable long-term aim, work within ABSS is currently not at such a stage and significant work and refocusing would be required to achieve this. It was also proposed that a general “theory” of emergence should be an aim of ABSS. Such a theory would enable MAS workers to engineer emergent properties. It was however noted that we have no idea what such a theory should look like (would it be formal? If so, what kind of formalism?) or how to make progress towards it (what is emergence?).

The assumption underlying the idea that ABSS can help to produce more robust and well co-ordinated MAS – namely that social systems possess such properties – was challenged. It was noted that social systems are often dysfunctional and unstable. It was expressed that it is often those very dysfunction properties that are of interest for ABSS. It was suggested that in real social systems agents rarely share the same goals or views. In software engineering it would seem that goals are shared – the desired behaviour of the MAS as a whole. The general conclusion here was that it is those situations in which agents do not share goals (indeed possibly have conflicting goals) in which much ABSS work is relevant. This is where MAS struggles and ABSS thrives.

A request was made to identify a task domain for which ABSS might attempt to inform the design of MAS. The idea of a “design group” was proposed in which there are various specialist agents, manager agents and tasks. How might such a system be organised and

implemented? Reference was made here to work in “computational organisation theory” (see Carley et al 1998 – http://jasss.soc.surrey.ac.uk/JASSS/1/3/4.html).

An example in which social metaphors might inform the solution of a hard engineering problem was advanced. A large-scale system in which thousands of loosely coupled processors are required to balance computation load could make productive use of an ABSS-type approach. Here the idea of social observation and influence might help to advance solutions to a hard engineering problem. It was suggested that a further application area for ABSS-type models could be to the simulation (prototyping) of large-scale MAS in which human agents played a major role, essentially the idea being that the system as a whole can be empirically tested by simulating not only the interaction of computational agents but human agencies as well.

To summarise the conclusions of the first discussion group:

- ABSS-type models are of particular use when systems are composed of agents with partial and conflicting views and goals. It was suggested by a number of participants that it is this subset of systems in which ABSS work can be most productively applied.
- To produce synergies between ABSS and MAS we should identify application areas within MAS that manifest conflicts of interest between agents. The initial suggestion here was to investigate computational resource sharing problems as a possible area.
- The evaluation or “prototyping” of large-scale system MAS in which human agents interact with computational entities could be a productive area for the application of ABSS-type models. This may feed into concept of the “wired society” in which economic and social organisations are increasingly built upon electronic infrastructures.

The second discussion group focussed on the following issues:

- Approaches to validation of ABSS models in scientific policy contexts.
- The role of ABSS in participatory approaches to social and environmental problems.
- ABSS and Optimisation.

The link between these three topics (validation, participation, and optimisation) can be summed up in the question: How can ABSS help in the selection of social policy? More specifically, is it possible to use it to select a policy that is in some sense optimal? Can an agent-based model's quality or usefulness be judged by whether individuals and groups with an interest in the policies being considered ("stakeholders" in current jargon) find it plausible and acceptable?

Focus session

This session was chaired by Paul Davidsson and Scott Moss and the first topic that was discussed was the ABSS technological road map. Paul Davidsson presented the current draft and focussed on the new additions to the previous draft. One of these additions is the characterisation of the field of Agent-Based Social Simulation as the intersection of three scientific fields, namely, agent-based computing, the social sciences, and computer simulation. While the main focus of ABSS, at least according to this characterisation, should be the area where all the three fields intersect, much interesting and relevant work is carried out in the areas where just two of the fields intersect. For instance, the intersection between the social sciences and agent-based computing concerns Social Aspects of Agent Systems and includes the study of norms, institutions, organisations, co-operation, competition, “social agents” etc. The activities belonging to the intersection between computer simulation and agent-based computing are often labelled Multi Agent Based Simulation and study the use of agent technology for simulating any phenomena on a computer. Finally, the intersection between the social sciences and computer simulation is typically called Social Simulation and corresponds to the simulation of social phenomena on a computer using any simulation technique and is typically using simple models of the simulated social entities, e.g., cellular automata and objects, that are able to perform only very basic interaction. Consequently, ABSS can be said to investigate the use of agent technology for simulating social phenomena on a computer.

Another aspect that was pointed out was that through its interdisciplinary flavour, ABSS has a unique potential for providing cross-fertilisation between the participating fields. In fact, we were able to identify (possible) contributions mediated by ABSS from each of the three fields to each of the other two fields. Although the presentation of the roadmap sparkled a lively discussion we drew the conclusion that the view presented in the road map seem to be shared by the other participants.

The next part of the session was devoted to software engineering aspects of ABSS. Nuno David discussed appropriate simulation platforms for ABSS, Craig Tunstall continued with a presentation on socially inspired methodologies for MAS development, and finally Leon van der Torre brought up the role of formal models (in particular deontic logic) in ABSS.

An important issue for the SIG to find appropriate applications of ABSS, both industrial and academic. Iqbal Adjali suggested an industrial application, namely, using ABSS for understanding business processes of network industries. Ales Kubík followed this up with a suggestion of a more research-oriented application, using ABSS for understanding emergence in MAS. Based on these presentations and the earlier discussions Jim Doran initiated a more general discussion on the issue of when to use ABSS. These areas were regarded as the important aspects to work on for next time.

SIG05: Special Interest Group on Intelligent and Mobile Agents in Telecommunications and the Internet (SIGMA)

The main purpose of SIGMA is to provide a forum for discussion and collaboration between researchers and industry on the topic of intelligent and mobile agents in telecommunications and the Internet.

The overall aim of SIGMA is to:

- Raise awareness within industry of the value of mobile agent technology and applications based thereof.
- Demonstrate the potential of this technology for solving industry and research problems.
- Facilitate the transfer of agent technology, skills, standards, and best practice from academia to industry.
- Provide feedback on industrial problems and requirements to agent researchers.
- Disseminate information on up-to-date research and development of agent technology.
- Engage in AgentLink's teaching and training activities on mobile agent related subjects.
- seed projects among SIG members

  SIGMA strives to establish cooperation between both researchers and and industry, arrange contacts, and focus dispersed research and development efforts. Interdisciplinary work is particularly welcomed.

  SIGMA collaborates with other AgentLink SIGs, and complements their work with a focus on mobile agents.

  The primary means of communication within the SIG are the SIG's mailing list and Web site, as well as SIG meetings (1-2 per year). Meetings are organized usually in

concomitence with AgentLink meetings, Conferences, Workshops and other events that are strongly related to the SIG's working area.

SIG05: First Meeting, Prague, 9-11 July, 2001

Introduction

The Special Interest Group on Intelligent and Mobile Agents (SIGMA) met for the first time in the course of the AgentLink II General Meeting. The meeting took place at the university of Prague, the capital of the Czech Republic, not far from the castle and beautiful old town of this famous European city. SIGMA organized two sessions, one of which was jointly organized with the Special Interest Group on Methodologies and Software Engineering for Agent Systems (MSEAS).

SIGMA session

The second session was on mobile agent technology and infrastructure, and consisted of a series of talks followed by a lifely discussion of SIGMA activities and goals. Unfortunately, the schedule for this session proved to be too aggressive. The discussion had to be terminated unresolved with already half an hour of overtime. This also required cancelation of the demo slot that was originally planned as well. Nevertheless, the discussion showed that there is considerable potential for cooperations between several of the SIG members (see also section~\ref{sec:roadmap}).

The first speaker was Lars Hagen from IKV++ Technologies AG, who gave a presentation on IKV's strategy to establish their mobile agent technology as a core technology of the e*nago* Platform Suite. *enago* is IKV's flagship product for building portals targeted at mobile service integration. Lars gave his presentation in place of Thomas Magedanz, who unfortunately couldn't attend the meeting. The presentation triggered a series of interested questions that unfortunately had to be broken off at some point in favor of subsequent talks.

The second talk was given by Peter Brown of University Jena. His talk was about different migration strategies for mobile agents and their impact on migration performance under various network constraints. The strategies are implemented and tested with the T*racy* mobile agent system that is developed at University Jena.

Ulrich Pinsdorf from Fraunhofer IGD gave the third talk, after the coffee break. His presentation informed on IGD's activities and concepts in the area of mobile agent systems interoperability. Rather than pursuing a top-down approach based on standards, IGD chose to follow a bottom-up approach based on voluntary interoperability. This approach is based on design concepts and abstraction that facilitate the creation of adaption layers for agents of various systems.

The final talk of this session was given by Stanislaw Ambroszkiewicz, of the Polish Academy of Sciences, on Agentspace as a middleware for service integration. Agentspace is an environment for agents that stems from the area of process automation in the Internet. At the heart of Agentspace is the language *Entish*, in which tasks of an agent are expressed.

Joint session with MSEAS

The joint session focussed on ‘‘mobile agents and software engineering," a topic that was considered of major interest because mobile software agents push the flexibility of distributed systems to their limits. Not only are computations distributed dynamically, the code that performs them is also distributed. As a consequence, mobility of agents brings both new challenges for software engineering as well as new opportunities.

On one hand, mobility requires new techniques for modelling, developing, testing, debugging, and deployment of mobile agents, as well as for the coordination of mobile agents in the scope of a distributed multi-agent application. It is fair to ask what current software

engineering techniques bring to bear on these challenges. On the other hand, mobile agents also offer striking opportunities to the field of software engineering. Once the concept of mobility is fully understood, its abstractions may prove to be a complementary and valuable tool for the design and implementation of complex distributed systems.

The goal of this session was to shed some light on these issues from various angles, with two renowned speakers in this area in the first half of the session.

In the first talk, Luc Moreau from the University of Southampton, tackled the problem of transparent communication between mobile agents. His approach is based on forwarding pointers, and avoids vicious cycles in the routing of messages that might emerge from cycles in the itinerary of a mobile agent. Both correctness and termination of the message delivery algorithm can be shown, given that the agent eventually stops or migrates slower than messages are propagated.

The second talk was by Gian Pietro Picco from Politecnico di Milano, who gave a critical review of the field of mobile agents from the perspective of software engineering. His talk touched a broad spectrum of issues ranging from the ‘‘general argument for mobility” to abstractions and systems design.

The second half of the session consisted of three short talks from Cristophe Silbertin Blanc, University of Toulose, on mobile agent behaviors and their transition from declarative specification to implementation; Walter Binder, CoCo Software Engineering GmbH, on how to build secure mobile agent systems in Java; and Alex Poylisher, Warwick University, UK, on distributed process networks with mobility based on aggregation nets.

All presentations triggered several questions and occasionally a lively discussion by the audience. Consequently, we had to cancel the panel discussion that was originally scheduled at the end of session because of a lack of time.

Roadmap

In his talk, Gian Pietro Picco noted that the majority of mobile agent related publications iterate well-known qualitative arguments for mobile agents rather than giving quantitative ones, and members of SIGMA criticized a general lack of demonstrable applications in the discussion that took place during the second session. These facts may also explain the absence of representatives of the telecommunications industry, who participated in the IATA SIG, but did not decide to join SIGMA.

Consequently, the work of SIGMA must be directed at establishing showcases of mobile agent technology that demonstrate the actual benefits of this technology and its applicability to real-world problems. Therefore, demonstration of ideas will play a major role in the planning of future SIGMA meetings, in order to spark interest by industrial members. The goal is to establish a dialogue between those who understand a particular problem, with researchers and developers that understand how and when to apply mobile agent technology. Only then may qualitative arguments translate into quantitative ones. A focus is clearly on telecommunications and Internet applications.

Although SIGMA is still a rather small SIG with about 12 members, discussions between several SIGMA members revealed a confluence of interests that can be brought to bear on the problem of demonstrable advantages of mobile agent technology. For instance, the University of Jena already operates a small testbed for their mobile agent system *Tracy*, which is distributed across Germany. Fraunhofer IGD recently agreed to donate a machine as well. It is our hope to extend this testbed gradually, and to use it for testing and demonstrating applications outside of a pure laboratory setting.

Besides these practical issues, it is apparent that mobile agent technology still requires a considerable amount of research - and philosophy. This conclusion can be drawn from Gian Pietro Picco’s talk as well, who put forward a number of questions that need to be addressed in the future. For instance, ‘‘why is everybody developing mobile agents in Java?” In fact, the

proliferation of the Java programming language led to the development of numerous mobile agent platforms.

Java seems perfect for developing an execution environment for mobile agents because Java offers many features that ease its implementation and deployment. Java runtime systems are available for most hardware platforms and operating systems. Therefore, mobile agent platforms that are built on Java are highly portable, and run seamlessly on heterogeneous systems.

However, growing experience with building Java-based mobile agent systems also reveals a number of severe weaknesses. Foremost is a lack of resource control and separation of applications that run in the same virtual machine. Among other things, this leads to the existence of various forms of *Denial of Service* attacks that can be used to bring down a Java Virtual Machine. Building a reasonably scalable, secure and industrial-strength mobile agent system based on a COTS Virtual Machine thus requires a tremendous effort, and may well bring serious restrictions on the core packages that are available to Java programmers.

In order to accomodate the requirements of mobile agent technology, the capabilities of the Java Virtual Machine have to be extended, and further mechanisms must be provided in the default Java environment. One way to achieve these goals is by means of the *Java Community Process*. SIGMA can help to form a lobby that pursues this goal as a mutual interest.

APPENDIX A:

MINUTES OF MANAGEMENT COMMITTEE MEETINGS

Minutes of the AgentLink II Management Committee

London, Tuesday 21 November 2000

Present:

Michael Luck (MML - Chair, general coordinator)
Michael Wooldridge (MJW - associate coordinator)
Yves Demazeau (YD - WP2 coordinator)
Paul Davidsson (PD)
Matthias Klusch (MK)
Joerg Mueller (JM - WP1 coordinator)
Carles Sierra (CS)

Apologies:

Magnus Boman
Rosaria Conte
Wiebe van der Hoek
Nick Jennings
John Perram
Gerhard Weiss

1. Welcome [MML]

MML formally welcomed the members of the management committee to the first official meeting of AgentLink II, which started on the 1st of August 2000.

2. Status of AgentLink II [MML]

MML briefly reviewed the level of membership since the end of Otober 2000. AgentLink II is a new project, requiring all embers to complete new membership agreements. Those nodes

that returned signed membership agreements by the end of October are deemed to have begun their membership at the start of the project. This number stood at 83 members, with several further member nodes having been added since.

New applications for membership had already been received from over 15 new institutions, with decisions largely being taken offline. The meeting reviewed these decisions, noting the inclusion of applications from new Associated States.

MML informed the meeting that the recruitment process for the two administrative posts for AgentLink II was well under way, but that no appointments had yet been made.

In October, MML and MJW met with the Project Officer in Brussels, and reported on their discussions. Project review meetings were intended to take place every 6 months with the Project Officer.

Copies of the budget for AL2 were distributed showing what funding was available and how it had been allocated. The meeting recognised that funding was already largely earmarked for activities, and there was comparatively little scope to take onboard new ones.

3. Summer school [MML]

MML reported that the summer school for 2000, held in Saarbruecken, and hosted by DFKI, had been a great success. This was despite the difficulties that had been caused by the timing of the school at the very start of AL2 and the uncertainties that arose over funding as a result. MML thanked MJW and GW for their organisational efforts, and made particular mention of the excellent work done by MK and Klaus Fischer at DFKI in the local organisation in the difficult circumstances. MK reported on the attendance figures: there had been 164 participants, comprising 112 students, 32 academics, and 20 from industry.

Preparation was well underway for EASSS 2001, which is being organised as part of ACAI. ECCAI and AgentLink are both contributing to a joint event in Prague, for which a provisional list of speakers had already been constructed and posted on the web. It was agreed that AgentLink should also try to colocate SIG meetings in Prague at the same time.

The meeting agreed to locate the 2002 summer school near Bologna to take advantage of colocation with agent conferences there.

4. AAMAS subscriptions [MML/NRJ]

The meeting received a proposal from NRJ to fund subscriptions to the International Journal of Autonomous Agents and Multi-Agent Systems for each member node. Apart from the obvious immediate tangible benefit to members of this, AgentLink would be offered special issues of the journal to showcase European research, as well as advertising space for AL and its events. After some discussion, it was agreed that assuming money could be found to cover this, and permission was given by the Project Officer, AgentLink would fund such subscriptions if

- two special issues were made available toward the end of the project in late 2002 or early 2003;
- a few pages of space were provided more regularly for short reports of AL activity; and
- the AL logo was included on the journal cover.

5. Meeting Calendar and Organisation [MML]

The meeting considered the structure and organisation of the AgentLink events calendar. There was a consensus that it would be better to hold fewer meetings with more people attending (ensuring a critical mass) rather than more, smaller events. It was agreed that the ideal calendar would include 2 events per year, one focussing on SIG meetings, and the other being the summer school.

The provisional calendar agreed for AgentLink II is 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

MML reported that the next major event was scheduled for 22-23 February in Amsterdam, at which 3 SIGs would meet. At present, it was looking difficult to find rooms in a university and a hotel had been provisionally booked - although this would increase the cost, it was important to move these meetings forward as soon as possible.

The structure of SIG meetings was discussed at length. The meeting considered how best to encourage and improve industrial involvement in these activities, and how to make the most valuable use of time. It was agreed that feedback should be sought from AgentLink members, and that while the February meeting was too early to respond to this, it should be used to inform meetings for the remainder of AgentLink II.

For February, some SIGs (eg I2A and AMEC) were already intending to invite industrialists to address their meetings, and it was felt that these people might fruitfully contribute to a better view of the industrial perspective to the entire assembly. It was agreed to try to use the first day of the next meeting to focus on plenary sessions with invited speakers from industry, and the second day for breakout sessions for separate SIGs.

MML reported that Franco Zambonelli had agreed to become coordinator of the Software Engineering and Methodologies SIG - the meeting warmly approved and welcomed this news.

The IATA SIG was currently undergoing a change of coordinator. The possibility of finding a stronger focus for mobile agents in this SIG was discussed: although distinct from telecoms agents, it was felt that the communities had much in common, and a combined SIG might offer some fruitful interaction. MML would explore this further.

6. Inter-Network SIGs [MML]

MML reported that Michael Fisher had been identified as responsible for the area of logic and agents in the new CompulogNet proposal, and was keen to formalise the relationship between the networks. MJW proposed that a formal inter-network SIG be established with Michael Fisher as coordinator, to be jointly funded by AgentLink and CompulogNet, with AgentLink providing no more than half the support it contributed to full SIGs. The meeting agreed with this proposal.

MML also raised the possibility of more formal interaction with I3Net. It wasn't clear to the meeting that this would be as successful - the meeting decided to use the Spring Days workshop (see next item) as a means for considering the value to the agent community of such an initiative.

7. Workshop requests for support/sponsorship [YD]

YD reported on the results of his workpackage committee's deliberations on requests for workshop and conference support. After some discussion of their recommendations, it was agreed that they would be funded as follows.

- Autonomous Agents - to request permission from the Project Officer for 4000 Euros to support AL2 student members with papers, reciprocating the NSF support for students to attend the summer school in August.
- MAAMAW - 4000 Euros for student members with papers
- AISB workshop - 1000 Euros for an invited speaker
- i3net workshop - 1000 Euros for AL2 students
- CIA - 4000 Euros for AL2 student members with papers.

8. Inter-node visits [RC]

The committee recognised that there was no money in the budget for this activity, and that it would require a substantial contribution to proceed. MJW noted that the inter-node visits agreed in AL1 did not offer critical value, and that they would make sense only if restricted to East European countries for whom this was likely to be far more valuable, or for industrial visits. The meeting agreed that given the budget, it was not possible to establish such visits at

present, but the situation would be reviewed in the light of the financial situation after one year.

9. Any other business [MML]

MML reported that a request had been made for AL2 support for seminar speakers, but the meeting agreed that this sort of funding was not appropriate for AL2.

MML suggested using national scientific and computing organisations to find new routes into relevant communities to engage with AgentLink activities, and encouraged MC members to make such contacts.

MML also proposed an occasional AgentLink lecture series, directed at practitioners in industry and commerce. Each lecture would be a prestigous evening event at a different major European centre, with an invited professional audience, and a local keynote speaker. The idea would be to engage with the broader IT community, and to encourage contact with those unfamiliar with agent technology. The meeting agreed with the principle, but note the absence of a budget for this. MML would explore how such an activity might be funded.

10. Date and location of next meeting [MML]

The next meeting would be colocated with the SIG meetings in February.

Minutes of the AgentLink II Management Committee

Amsterdam, Wednesday 21 February 2001

Present:

Michael Luck (MML - Chair, general coordinator)
Magnus Boman (MB)
Paul Davidsson (PD)
Frank Dignum (FD)
Wiebe van der Hoek (WvdH)
Scott Moss (SM)
Eileen Simon (ESS)
Michael Wooldridge (MJW)

Apologies:

Yves Demazeau
Nick Jennings
Matthias Klusch
Joerg Mueller
John Perram
Carles Sierra
Gerhard Weiss

1. Welcome [MML]

MML welcomed everyone to the second meeting of AGENTLINK II.

2. Status of AgentLink II [MML]

- **Membership**: MML reported that from AgentLink I, 83 members have continued with AGENTLINK II. The number at 31 January was 106 approved 'full' members.

- **Admin posts**: MML reported that although AL2 had got off to a slow start because of delays in appointing staff, the current situation is that AL2 is now fully staffed as follows:

    - Elizabeth Coulter-Smith (ecs2@ecs.soton.ac.uk): Web and Publications Coordinator. MML requested suggestions from the committee regarding the web site, publications and the Newsletter.

    - Eileen Simon (ess@ecs.soton.ac.uk): Administration and Events Coordinator.

- **Finances:** MML distributed a summary of the current financial state of AL2, which showed limited expenditure (before the Amsterdam meeting). SM requested a breakdown of the figures showing where we are in the state of the budget against projections. ESS to add projections and six month breakdowns.

3. Membership Applications [MML]

- **Criteria:** MML reported that the membership criteria had been made clearer and more explicit, and that these were now available on the web for perusal by prospective applicants**.**

- **Application:** New applications had been received from N institutions. The meeting reviewed and confirmed the decisions taken offline.

4. Summer School [MML/WvdH]

- **EASSS'01:** MML reported that plans for the Summer School in Prague in July are well underway, and online registration is now possible at http://cyber.felk.cvut.cz/ACAI01/. It will be held this year between 9-11 July, in collaboration with ECCAI's Advanced Course on Artificial Intelligence (ACAI-01),under the joint heading of Multi-Agent Systems & Applications (MASAP).

- **EASSS'02:** The 4th European Agent Systems Summer School will be held in 2002 in Bologna, Italy – local organiser will be Paolo Ciancarini, at the University of Bologna. MML and WvdH to seek suggestions for courses and lecturers.

5. Meeting Calendar and Organisation [MML]

- **Prague:** The next major AL2 meeting will be held in Prague on 9-11 July, to coincide with the summer school. Following requests from members, the format for future SIG meetings would change. As so many people wanted to attend more than one SIG meeting, the meeting agreed that parallel sessions would be set up to open the meetings to more people and possibly increase the SIG participation. Each SIG would then request slots in the overall schedule for a more integrated, coherent and inclusive meeting. MML would be requesting SIG leaders to contact him as soon as possible with their requirements.

- **SIGs:** Rosaria Conte is standing down from the Agent Based Social Simulation (ABSS) SIG, and is replaced by Scott Moss as coordinator and Paul Davidsson as co-coordinator.

  Volker Roth has agreed to take over as coordinator of the IATA SIG to replace Steve Corley (who has stepped down) and to find a place for mobile agents as an explicit focus within it.

  Franco Zambonelli has agreed to take over the Methodologies and Software Engineering SIG from Jan Treur.

  Gerhard Weiss announced his intention to stand down from WP3 on Education and Training. Wiebe van der Hoek, already in the WP3 committee agreed to take over as WP3 coordinator.

  The meeting noted its appreciation to all those stepping down for all the hard work they had done in AgentLink and AgentLink II; the new coordinators all hope to continue the good work done by their predecessors.

  AgentLink-CologNet SIG: MML reported that a proposal had been submitted as part of the CologNet network for an inter-network agents and logic SIG to be partially funded by AgentLink II. The SIG would receive approximately half the funding of existing SIGs as fits an inter-network SIG of this kind.

6. Workshop Requests for Support [YD/MML]

- **Proposed Rules:** The meeting considered the following proposal from the Research Committee in relation to guidelines for supporting workshops and conferences. It was agreed that these provided a sensible basis for considering AL2 support, but it was noted that these were guidelines rather than rules.

  Visibility: We should avoid funding general purpose conferences where Agents / MAS are only one topic of the CFP.

  Feedback: We should avoid duplicating funding for colocated events. It is more optimal in terms of AL2 publicity and expected return to spread it over time and

space.

Contractual: We should try to fund events located outside Europe, (even though this requires special authorization) but we should reserve these exceptions for major events.

- **Support:** The meeting considered the requests for support and the recommendations from the Research Committee, and confirmed the following decisions.

  AOIS Europe: funding would be awarded to a maximum of 1,000€

  AOIS Montreal: no funding.

  AISB 2001: No further funding available for this meeting (it was already being supported in one workshop).

  ATAL 2001: funding would be provided to a maximum of 1,200€ for an invited speaker.

7. Databases and Repositories [MB/MML]

MB proposed the reinvigoration of efforts to develop research databases and the web site. Now that AL2 was fully staffed, MML agreed that more effort could be devoted to this. MB proposed a map of Europe with dots representing each member being linked to the web page for each node and the people involved. MB also suggested the kind of information that each node would be required to provide. MB to prepare a template to be mailed to members. Each member site would also have a link to the AgentLink web site.

MML reported that the papers clearinghouse was now online at the AgentLink web site, and asked the meeting to begin populating it with publications.

8. Date and location of next meeting [MML]

The next meeting would be held in Prague around the time of the AgentLink SIG meetings in July.

Minutes of the AgentLink II Management Committee

Prague, Monday 9 July 2001

Present:

Michael Luck (MML - Chair, general coordinator)
Elizabeth Coulter-Smith (ECS)
Paul Davidsson (PD)
Yves Demazeau (YD)
Frank Dignum (FD)
Matthias Klusch (MK)
Scott Moss (SM)
Chris Preist (CP)
Volker Roth (VR)
Carles Sierra (CS)
Eileen Simon (ESS)
Franco Zambonelli (FZ)

Apologies:

Magnus Boman
Wiebe van der Hoek
Nick Jennings
Joerg Mueller
John Perram
Michael Wooldridge

1. Welcome [MML]

MML welcomed everyone to the third meeting of AgentLink II.

2. Status of AgentLink II [MML]

- **Membership:** MML reported that AgentLink now has 128 members, exceeding the number in the original proposal. We have received quite a few enquiries from Industry recently, which looks promising for the future.

- **Finances**: MML distributed a summary of the current financial state of AL2, which showed a breakdown of the actual expenditure, projected expenditure, annual budget, and the anticipated balance at the end of the year. The projected expenditure for Years 2 and 3 were also attached, showing an anticipated deficit in the travel category.

3. Membership Applications [MML/ESS]

- **Criteria:** Following a query from SM, the meeting agreed that continued participation in AgentLink meetings could be used as evidence of activity in agent based computing for the purposes of membership.

- **Applications:** have been received from 15 institutions, (eight from industry), from 1 May 2001 to date.

- **Agreements:** have been received from 18 institutions, (eight from industry), from 1 May 2001 to date.

4. Workshop Requests for support/sponsorship

- **CEEMAS 2001:** The meeting agreed that it was important to support developing activity in the Newly Associated States, and that the request for 4K Euro support should be granted; this will be 2K towards organization costs and 2K for Researcher travel support.

- **AAMAS 2002:** The meeting agreed that at least 4K Euro support would be granted; this would be at least 3K for student sponsorship, and up to 1K possibly for student awards or for local organization subject to providing AgentLink special visibility. The meeting recognized that it was probable that more requests for affiliated workshops would be received in time, and was minded to provide more to fund these as funds permitted.

- **North American Agent School:** In response to the success of the AgentLink summer schools, the US community is seeking to do something similar. MML received a request for funding from Milind Tambe to support students to attend a proposed winter school in California in January 2002. Because of the low budget available for support (largely already committed), and because of the annual European event, it was not possible for the committee to provide support at this time. However, the committee agreed to closely coordinate such educational activities with the US organisers, and to provide mutual support whenever possible. If the financial situation changed (possibly in relation to the education budget) it might be possible to consider some support later.

5. Databases and Repositories [MML/ECS]

MML reminded the committee that the various databases were available on the website, but needed more data to be added.

- The committee was asked to provide information relating to available software, particularly educational software, for the web site. If the URL address was sent to ECS (ecs2@ecs.soton.ac.uk), she would add it to the web site.

- A request for more publications to be added to the publications clearinghouse was made.

- More feedback is also needed from members in relation to information to include on the site for the benefit of the members and the community.

6. Technological Roadmap [MML]

MML reported that Christine Guilfoyle, who wrote the influential Ovum report on agents in 1994, had been engaged to develop the Technological Roadmap for AgentLink. The first outline draft of the Roadmap was distributed as a basis for discussion, despite still needing much work. The committee was asked to update the content and to respond to MML within two weeks ***(23 July)*** to provide feedback to Christine to enable a first draft to be made available to members for comment in a short period of time. It was hoped that it might be possible to provide a draft for comment by members in the Autumn. A two-tiered approach was proposed:

- A professionally produced brochure would be developed for use by policy-makers, R&D strategists, IT Directors and professionals. This will largely be developed by consultants with material provided by SIGs, research conferences, and other input from AgentLink.

- A more substantial version with more research and technical content, directed at the research community, would be produced as a book, or as a special journal issue. This would provide more scope for concentration on detailed technical and research issues that might not be relevant to the more strategic version.

7. Summer School [MML/WvdH]

- **EASSS'01:** MML reported that the Summer School seemed to be progressing well, with around 180 participants.

- **EASSS'02:** The 4th European Agent Systems Summer School will be held in 2002 in Bologna, Italy for one week, immediately prior to the AAMAS Conference. MML reported on discussions earlier in the week with MJW and WvdH. The local organiser will be Paolo Ciancarini, at the University of Bologna, with some coordination assistance from Andrea Omicini and Franco Zambonelli. MML and WvdH to seek suggestions for courses and lecturers.

8. SIGs [MML/MK]

- **Review of current organisation of SIG meetings:** The current organisation of SIG meetings was discussed. Some concerns were raised about the timing of sessions and continuity, but generally it seemed to work well. MML and ESS would try to ensure that continuity of sessions would be sought for those who wanted it, provided that SIG coordinators communicated requirements, etc in good time to allow this.

- **SIGs update**

    - **Current SIGs:** Five of the six SIGs were active and were operating well. The meeting agreed to suspend the Coordination and Control SIG for the present, but recognized that there was genuine interest in it. MML to explore the possibilities for its reinvigoration.

    - **Learning SIG:** A proposal for an inter-network Learning and Agents SIG was received from Pete Edwards and Daniel Kudenko (among others). It was agreed that this would be a good activity to pursue as it cut across all existing SIGs, and would tie in with other networks. The committee agreed that Pete Edwards (and Daniel Kudenko), as coordinator, should pursue discussions with other networks such as EUNITE, ILPNet, and others, and work with MML on setting something up.

7. AgentLink Review Meeting [MML]

The Report from the Review Meeting in February had been received, and MML gave a précis of the report, outlining the responses to the key points and recommendations of the reviewers. AgentLink is currently meeting most of the recommendations given by the reviewers.

- **Management Committee representation:** The concern from the reviewers relating to the proportionate representation from the different constituents of AgentLink II was partly incorrect, probably due to the misrepresentation of MML. With the addition of CP, the committee now stood at 3 industrials (Jörg Müller, Siemens; Chris Preist, HP Labs; Nick Jennings, Lost Wax) 4 research institutes (Carles Sierra, IIIA-CSIC, Magnus Boman, SICS; Volker Roth, Fraunhofer IGD; Matthias Klusch, DFKI) and 8 acadmics.

- **Industrial events:** MML reported on his participation at the FIPA meeting in London in April, and on AgentLink representation at future FIPA meetings (see later). More generally, however, he described great difficulty in finding relevant and appropriate industrial events, having spent much time trying to identify them, and sought suggestions from the committee. It was recognized that this was not an easy task, and that it was important to find useful events rather than any industrial event that would provide a useful contribution. The committee felt that industrial events were important, but could not and should not be pursued regardless of the value they might bring. MML reported that he was to have a meeting with EVUS, the PR company that

organized the Lost Wax conference in January to see what other events might be possible in the future.

- **Agent systems and technology database:** In order to find a means for dissemination of the database among software houses, two possibilities were considered. A glossy flier might be developed with key software products and pointers to the full online database. CP also suggested the possibility of involving one of the AgentLink industrial members on a consultancy basis to develop a review of products for wider dissemination. MML to explore both possibilities. (MML also reminded the committee that the content of such databases relied on all members providing input.)

- **Standardisation:** MML reported on his participation at FIPA's London meeting and discussions on how to establish stronger links. Regular reports from those involved in FIPA and AgentLink were already underway, and efforts were in hand to formalize the relationship. See later item.

- **Relationship between WP2 and WP4:** It was agreed that the key activity of the research workpackage in sponsoring events would involve more specific targeting of feedback for contribution to the roadmap. A questionnaire would be developed by YD and MML for event organizers to prompt for research inputs to the roadmap and relevant SIGs where appropriate.

Summer Schools: The Summer Schools were on target for 4 events during AgentLink II

- without funding difficulty. Nevertheless, MML had tried to explore possibilities for interaction with NAS states in order to secure more funding. MML to continue discussions, even though the summer schools did not depend on it.

- **Curricula database and software:** The curricula database now provides a link to an extensive list of educational software, thanks to the efforts of ECS.

- **Cancellation of inactive SIGs:** As discussed earlier, the MACC SIG would be suspended and either replaced or re-established. MML to explore possibilities.

- **Roadmapping:** Work is already underway on the roadmap, as discussed above. The AgentLink strategy is for inputs to be provided by SIGs and sponsored research activities to Christine Guilfoyle for inclusion in the roadmap. Some discussion took place regarding the targeting of the roadmap, and it was agreed that it should be developed for a professional audience. A draft is planned for the Autumn, to feed back to members for comment. A second version will be produced for the end of Year 2, to be designed and professionally printed for distribution among the IT community. SIG coordinators were reminded that they must provide inputs to the roadmap in a timely fashion. MML and CP to develop further plans.

- **Industry and academia in SIGs:** SIG meetings are already being used to identify requirements from industry and feed them back to the academic community, as demonstrated by the plenary industrial-academia day in Amsterdam and eg the industrial session of the AMEC SIG. It was suggested that this can be enhanced by polling industrial members to elicit problem topics, areas of interest and requirements. YD has some experience of this. Additionally, the web pages can be updated to make explicit the relationship between SIGs and industry requirements.

- **Newsletter dissemination:** More newsletters for the latest issue of AgentLink News have been printed and the distribution list is being continually expanded. AgentLink members are encouraged to provide further names for the list.

- **Yardsticks:** MML has already started collating information relating to the yardsticks that were identified in the Technical Annex for measuring performance of AgentLink.

However, some of the yardsticks (as recognized in the Annex) are difficult to determine, such as number of proposals resulting. MML has begun polling members for information, and is maintaining these statistics as best possible. He requested that MC members complete the questionnaires distributed as soon as possible. Qualitative success factors are also difficult to identify. MML requested the committee consider this and respond with ideas and comments.

- **Industrial events report:** MML has already begun to prepare a report on the Lost Wax conference (and other industrial events), but noted that it was not possible to provide a list of participants due to the commercial and confidential nature of such a list. The report would be made available on the web site in due course.

- **Supported conferences report:** MML would complete a report on supported conferences to be made available on the web site.

- **EASSS'01 report:** MML would complete a report on EASSS'01.

The next review will be held in Bologna on 14 September 2001. It was recognized that some committee members would not be able to participate, but MML sought to ensure a broad representation from the SIGs and the workpackages.

9. FIPA Interaction [MML]

As part of the Industrial Action workpackage, MML attended a FIPA meeting earlier this year, where he began preliminary discussions on AgentLink-FIPA interaction. He has since proposed to FIPA that AgentLink sponsors a participant for their European workshops, and that FIPA provide regular articles for AgentLink News from their Image Committee. No reply has been received as yet.

10. Any Other business [MK]

MK announced that Sonia Bergamaschi would become co-coordinator of I2A (Intelligent Information Agents), and the committee welcomed her involvement.

11. Date and location of next meeting [MML]

The next meeting would be held during January/February 2002, venue to be sought; suggestions included co-locating with OnToWeb or AgentCities meetings, or possibly locating at HP in the UK, or Paris, Portugal or Spain.

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Towards an Online Distribution Structure?
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Project Reports:

A Multi-agent System for Analysing Synthetic Aperture Radar Atlas (SARA) Data
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Market-based Decentralised Process Management using Multi-agent Systems
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Grasshopper 2 - the Next Generation Agent Platform
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Conference and Workshop Reports:

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

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New Call for technology take-up project proposals for innovative users and suppliers of agent technologies or middleware for distributed applications
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DOCUMENTS PRODUCED BY AGENTLINK II IN YEAR 1 2001

- 2001-014.pdf:
  Minutes of Management Committee Meeting held in Prague on Monday 9 July 2001.

- 2001-013.doc:
  AgentLink member (industrial) questionnaire (word document).

- 2001-012.doc:
  AgentLink member (academic) questionnaire (word document).

- 2001-011.pdf:
  AgentLink member (industrial) questionnaire (pdf).
  AgentLink member (industrial) questionnaire (plain text version).

- 2001-009.pdf:
  AgentLink member (academic) questionnaire (pdf).

- 2001-008.txt:
  AgentLink member (academic) questionnaire (plain text version).

- 2001-007.txt:
  AgentLink email update #36, June 28 2001 (plain text version).

- 2001-006.pdf:
  Minutes of Management Committee Meeting held in Amsterdam on Wednesday, 21 February, 2001.

- 2001-005.txt:
  AgentLink email update #35, May 24 2001 (plain text version)

- 2001-004.txt:
  AgentLink email update #34, April 10 2001(plain text version)

- 2001-003.txt:
  Old version of member node profile form (plain text version).

- 2001-003.pdf:
  Old version of member node profile form (pdf).

- 2001-002.txt:
  AgentLink email update # 33, March 13 2001 (plain text version)

- 2001-001.txt:
  AgentLink email update # 32, February 2 2001 (plain text version)

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- 2000-014.txt:
  AgentLink email update # 31, December 12 2000 (plain text version)

- 2000-013.txt:
  Minutes of the AgentLink II Management Committee Meeting held in London on Tuesday 21 November 2000

- 2000-012.txt:
  AgentLink email update # 30, November 14 2000 (plain text version)

- 2000-011.txt:
  AgentLink email update # 29, October 20 2000 (plain text version)

- 2000-010.txt:
  Application form for new sites wishing to join AgentLink II

- 2000-009.pdf:
  Expenses claim form (PDF version)

- 2000-009.doc:
  Expenses claim form (MS Word version)

- 2000-008.txt:
  AgentLink email update # 28, September 4 2000 (plain text version)

- 2000-007.txt:
  AgentLink II proposal: reviewers comments, May 25 2000 (plain text version)

- 2000-006.pdf:
  AgentLink II proposal, May 19 2000 (PDF version)