PROFILES FOR UNIVERSAL PERSONAL IDENTIFIERS (PUPPIES)

PROJECT PROGRAMME

PART 2 - TECHNICAL

Project Partners

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1.5.1 Scenario 1 - Today's news - wherever I am

1.5.1.1 Basic Scenario

I have a range of interests and like to keep in touch with news. My personal Puppy knows what my interests are, and uses an agent to find information on subjects which are of interest to me. The basic information it provides may be gleaned from commercial news services, and the Puppy may authorise payment for some services, but other information may come from other sources on the Net - official sites or information servers, for instance.

My Puppy knows that I access information from a range of devices, and over time can learn my preferred access method in different situations. The Puppy formats the information according to the method by which I am likely to access it, and communicates that information to me. For instance, I may not be contactable via email over the weekend, but the Puppy could put together a 'magazine programme' which I could access via my television. If I am on a trip, the best method may be to fax the information to me, which would require very different formatting of the information - video clips would not be suitable, but in-depth editorial might be. The Puppy is aware of what formats are acceptable for which access-methods, and presents the information accordingly.

1.5.1.2 Extended Scenarios

Using access to my diary to determine where I am likely to be over the week, my Puppy can prepare information in a suitable format, but might also include information about cities which I might be visiting for the first time.

If I have a particular interest in a certain subject, the Puppy could contact me when something comes up in relation to that topic, or maybe give me information about my favourite singer as an introduction to telephone calls!

The Puppy can look at my documents to determine my interests, and try to identify news that reflects the subjects that are of interest to me at the moment.

1.5.2 Scenario 2 - Meeting arranger

1.5.2.1 Basic scenario

My Puppy has access to my diary, and can tell when I am available for different actions. However, I work with a team of people at work who regularly need to meet, so we have formed a 'federated' Puppy, which represents us. This Puppy has access to certain parts of my personal diary - it will notice, for instance, that I am booked out from work on Tuesday afternoon, but may not know that it is for a dentist's appointment. From time to time we need to have meetings with other people or groups of people, and the Puppies representing these people negotiate with our federated Puppy to arrange a time. The Puppy does this and arranges for my personal Puppy to update my diary.

1.5.2.2 Extended scenarios

It may be the case that all other members of the group are able to make a particular time for an important meeting, but that my diary has me booked as away on that day. The Puppy wishes to get in touch with me, and contacts my personal Puppy. My personal Puppy knows that I am currently not available by email - I am out of the office - but that I am contactable by mobile phone, and gives the federated Puppy my numbers. The federated Puppy phones me up and asks me whether I can make the time or not. I give the Puppy my answer 'Yes', interpreted using either touch-tone dialling or a voice-recognition system, and the Puppy books the meeting.

The Puppy may interact with an agent that books meeting rooms, and arrange for our meeting to be scheduled in a room that fits our requirements - we have twelve people attending the meeting, therefore a ten-person meeting room would not be suitable. If the meeting is scheduled to go over lunch, the Puppy can order sandwiches for us, negotiating with our personal Puppies over specific dietary requirements.

On certain occasions, it may be necessary to travel to a meeting. There is a budget allocated to the group, some of which the Puppy can access. It talks to an agent which handles rail ticket booking, and arranges tickets to the destination to allow us to arrive on time.

1.5.3 Scenario 3 - Worlds on your desktop

1.5.3.1 Basic Scenario

Note - this scenario is in part an adaptation of ideas from UK Wired magazine, July 1996, p. 23 *The Smiley Accountant* and from the book *Interface* by Stephen Bury. Both these sources posit the use of simple graphical models to communicate information about a complex system.

Following the model of the federated Puppy in *Scenario 2* above, the company for which I work has a company Puppy. Although my personal Puppy does not have access to all details about the company, in the way that the Puppies belonging to the company CEO might do, there is certain information about the state of the company that the company Puppy can communicate to me via my personal Puppy. For instance, one of the duties of the company Puppy might involve project management. Although I am not involved in the day-to-day running of most of the projects in the company, it may well be of interest to me to see how they are progressing. The company Puppy provides graphical representations of how the projects are progressing; for instance, a globe, whose size represents the number of people working on the project, whose weather system reflects how close it is to completion, etc.. This information is taken from a variety of different systems, and may come from a variety of Puppies - my team's Puppy, for instance, may provide information about how well we are keeping to budget on our project.

1.5.3.2 Extended scenarios

As the information is being communicated to me via my personal Puppy, my personal Puppy may influence the way in which the information is processed. The brightness of the

globes in the example above might reflect my influence in the project - if I am working 40% on a project and 60% on another, this will show in the display of the globes.

It may be the case that one of the projects on which I am working needs attention - clearly this will be reflected in the 'health' of the globes. However, my personal Puppy may, in consultation with the team Puppy, recognise that prompt action on my part will make a large difference to the health of the project. This would be displayed graphically in the representation of the globes on my display, but would not necessarily be the case for other members of the team.

1.5.4 Scenario 4 - Shopping

1.5.4.1 Basic scenario

My Puppy has access to a shopping agent. As my Puppy knows what my preferences are for basic items, it can carry out a series of negotiations with one or more suppliers via the agent. It asks me if I have any particular requirements (or I can request its services if we have got low on particular items), and then contacts the suppliers. It works out the cheapest way to get all the shopping I need, possibly getting certain items from different suppliers, depending on the price at the time. It then looks at my diary and my partner's diary and sets a delivery time when at least one of us will be at home. Having arranged a delivery time, our diaries are updated.

1.5.4.2 Extended scenarios

My Puppy may be set to run once a week - or have set itself to do this, having learnt that the best time for a delivery rarely varies. If it 'notices' from our diaries that my partner and I have been out for a couple of nights and will be away over the weekend, it can vary not only the time of the delivery, but also the amount of food that it orders. At a very fine level of granularity, it might be aware that we always eat fish on Fridays, but not bother to order any this week, as it notes that we have an appointment that involves our dining out this Friday.

A group of people who live close to each other - in the same village, for instance - might decide to cause their Puppies to work together. This federated Puppy could have access to **certain** parts of the diaries of all members of the group, allowing a delivery to be made to one member, who could then distribute items as needed. More important than ease of delivery, this would allow purchases to be made in bulk, getting a better deal for everybody. There is no need, in fact, for this grouping to be geographical - in the case of some commodities, a large order might make a product run viable.

The Puppy can, of course, cause the shopping agent to be affected by other factors. For instance, it might be set up to watch the forecast during the summer and buy barbecue commodities when a warm weekend is due!

1.5.5 Scenario 5 - Transport

1.5.5.1 Basic Scenario

I am making a journey which involves quite a long drive, and I wish to avoid traffic as much as possible. I tell my Puppy where I want to go, and when and the Puppy, using a route-planning agent, plans a route for me. Unlike most traditional route-planning methods, however, the agent that my Puppy uses negotiates with a traffic control system to decide the best route. Also, as my Puppy has communicated with the traffic control system, the latter now has more information that it can feed back and use to update forecasts of where traffic will be. In fact, the traffic control system may well be a federated Puppy of several different traffic control systems, which means that local traffic information can be accessed for other uses such as planning construction or road repair work.

1.5.5.2 Extended scenarios

A group of people who regularly travel long distances could federate their Puppies to allow car-sharing, thus saving fuel costs and, if the group were large enough, reducing congestion.

My Puppy could keep track of where I am using some positioning system, and contact me by mobile phone or in-vehicle screen if the traffic ahead required a change of route. It would pass this information to the traffic control system, which would be better able to divert traffic sensibly, rather than making all vehicles do the same diversion, no matter where they are headed.

1.6 User Benefits

1.7 Risk

1.8 Objectives

1.9 Success Criteria

2. STATE OF THE ART

2.1 Object Technology

2.1.1 Architecture Road Map

2.1.2 Implementation Technologies

2.1.3 References

2.2 Agent Technology

Agents are typically software-based computer (sub-)programs which are autonomous in that they have control over their own actions/state, i.e. they do not need user intervention to function, social in that they interact with other agents in their environment, possibly including users, and are able to exhibit goal-directed behaviour whilst being reactive to environemntal changes.

Traditional Artificial Intelligence (AI) and Distributed AI (DAI) techniques have been applied to agent systems in a number of ways. Various models have been proposed to develop theories of "agency" which use traditional AI formalisms such as intentionality, beliefs, desires, etc. For example Cohen & Levesque's [1990] formalism, originally intended to develop a theory of intentionality, has been expanded to analyse competitive and cooperative agent communications [e.g. Jennings 1992]. Wooldridge [1992] presented a family of logics to represent the properties of multi-agent systems and used it to construct formalisms that could then be used to specify agent systems. Werner [1989] has used economics, game theory and philosophy to develop a complex general model of agency.

The agent architectures devloped in the D/AI community range from traditional planner-based approaches to those which use Brooks' [1990] purely reactive subsumption architecture. Wood's [1993] has developed a simulated traffic system AUTODRIVE in which planning agents operate. Vere and Bickmore [1990] have developed HOMER, a simulated submarine agent which exists in a 2-D environment. HOMER is able to receive commands in an 800-word sub-set of English from a user and then execute them with modifications if necessary. Agre and Chapman [1987] presented the PENGI computer game in which a subsumption-like architecture controls the central character. Hybrid architecures have also been presented which use subsumption and planning in multi-layered approaches such as Burmeister and Sundermeyer's COSY system [1992] and Muller's InteRRaP [1994].

Complex and potentially powerful structured agent communication frameworks have also been developed using AI formalisms. For example Fischer's [1994] Concurrent MetateM language system contains a number of concurrent temporal logic agents, each of which is able to communicate with other agents via asynchronous broadcasts. General Magic Inc. have presented TELESCRIPT [White 1994] which is a language-based environment for constructing societies of agents. The TELESCRIPT system contains the language, an engine which handles schedules for agent execution, communications, etc. and a set of software tools to support the developement of agents.

None of the above mentioned work includes any form of agent adaptation, however the field of Machine Learning (ML) has also begun to examine multi-agent systems

2.2.1 Machine Learning Agents

The established learning algorithms of this field are being extended to multi-agent systems. Neural networks, the L* algorithm (as the US-L* [Carmel & Markovitch 1996]), ACE in which agents send propoed actions to each other for scoring [Weib 1993], and Case-based Reasoning [Ohko et al. 1993] have all been tried.

The reinforcement learning technique known as Q-learning which uses learnt (stochastic) selection biases to generate appropriate behaviour has been extended to multi-agent systems in a number of ways. For example Mikami and Kakazu [1994] have added neighbourhood reward sharing for both cooperative and competitive systems finding benefits in the former case. Tan [1993] has added the ability for agents to share experiences by exchanging sensations, actions and rewards which the receiver uses to update its own Q-values (biases).

2.2.2 Evolutionary Computing Agents

Evolutionary Computing (EC) has recently been extended to work in multi-agent systems. Husbands and Mill [1991] were the first to evolve separate sub-populations for an overall cooperative task, that of machine-shop scheduling. That is, the evaluation environment of each evolving agent contained an individual from other evolving populations. Here a separate population of potential plans was evolved using a genetic algorithm (GA) [Holland 1975] for each component. Bull and Fogarty [e.g. 1994, 1995] presented a communicating rule-based arhcitecture for the application of such techniques to multi-agent systems. Here each agent type is evolved by a separate population and during their evalutioan the agents can pass messages to each other using a simple mechanism. It is shown that communication strategies will emerge between interacting agents along with evolved multi-agent solutions to given tasks. Seredynski [1994] has shown that if evoving agent share fitness locally the global optimum can be found in the a v

2.2.3 References

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3. PROJECT STRUCTURE AND WORKPLACE

3.1 Participants And Their Roles

Partner	Country	Function
APM	UK	ANSA Consultants
University of the West of England	UK	Academic Research

3.2 Work Package Descriptions

3.3 Project timescales

3.4 Resources

Participant	Efforts per Workpackage (WP) in person month														Effort Person Month
	WP1		WP2		WP3		WP4		WP5		WP6		WP7		
	E	R	E	R	E	R	E	R	E	R	E	R	E	R	
APM															
University of West England															
TOTALS															

Form 5.3 E= Effort (person months) R= Role

3.5 Deliverables

Types of deliverables	Description of the deliverable	Avail.	WP ref.	Responsible/ involved partner	Project Month
Reports	Quarterly Reports	R	7	APM	Quarterly
YEAR 1					
YEAR 2					

Form 5.1

The responsible partner is the partner in charge of the work package that produces the deliverable. All participants within that work package will be involved in producing the deliverable.

Each deliverable will undergo a review process before it is released. This deliverable may be an external review by the Commission, a technical review by the technical committee or a review by the user/ User Group. The reviews that will be undertaken for each deliverable are shown in the table below. External review milestones are detailed more fully in the following section

Deliverable	Review Type

3.6 External Review Milestones

Number		Type	Month
MS1			
MS2			
MS3			

4. PRINCIPLES OF OPERATION OF THE PROJECT

4.1 Consortium Structure

The consortium will define a consortium agreement which will be agreed within the first three months of the project start and which will cover such topics as exploitation by individual consortium members and intellectual property rights. Within the consortium agreement, all partners and associates will have equal rights and obligations. The consortium agreement will also address the question of rights and access to background information brought into the project by consortium members.

4.2 Project Management

APM will act as co-ordinator and project manager. It is well qualified to do this, having successfully managed and been involved in several Esprit and RACE projects. The team which manages this project will be the same which managed the successful ISA project which has some 20 partners across Europe, big and small, a budget of 22 MECU and which was completed on schedule, to budget and which has resulted in over 15 successful working systems and products by the project partners.

The management team is the same as that which managed the ISA project. It is well known and respected in companies across Europe:

- PROJECT DIRECTOR: Michael Eyre - Marketing, dissemination, general project management
- TECHNICAL DIRECTOR: Andrew Herbert - Technical direction, quality, standards

4.3 Co-ordination, Progress and Change Management

4.4 Participation in programme

5. EXPLOITATION PLAN

5.1 Exploitation Channels

5.2 Validation and Proving

5.3 Standards

5.4 Dissemination

The Project will use the established ANSA routes for dissemination of its results. These give world-wide exposure, through the WWW, Email, submission to journals, printing of booklets (over 4,000 copies of the ISA result have been circulated) and through the annual ANSAworks Conference, which attracts an audience of some 200 delegates, world-wide.

The project will also benefit from dissemination through the academic channels via the academic contributor to the project. Other means and dissemination channels, like the World Wide Web will be looked at, as possible candidates.

5.5 Spin-offs

5.6 Exploitation Plans of each partner

5.6.1 APM

APM intend to exploit the results ... will also market the appropriate part of its results to the sponsors of its ANSA Work programme of advanced development in distributed networked systems. The sponsors include BT, France Telecom, ICL, Bell Communications Research, GPT, GEC, Northern Telecom (Nortel), Telefonica, Barclay's Bank, Iona Technologies, Prism Technologies, the UK Defence Research Agency and Eurocontrol, encouraging their use of the results in products and their support of standards initiatives.

The experience of this system will be valuable to APM's growing consultancy business. APM will also use the results in its training courses. APM expect to be able to use the

results of the trial application as another real life example of the application of its ANSAware technology and architecture. This will contribute to increase the acceptance of ANSA in the industry.

If appropriate, APM will also be responsible for leading the input of project work to relevant standards. It has an excellent track record in this field, having led the ISO standard 10746 (Open Distributed Processing, work which was largely done within the Esprit ISA project), it made major contributions to the OSF DCE and OMG CORBA, and a member of APM's staff has chaired the OMG's CORBA 2 Task Force for the past two years. APM is a founder member of OSF, OMG and the WWW Consortium. It also has excellent co-operation with the TINA Telecommunication Integrated Network Architecture Consortium.

5.6.2 UWE

The Intelligent Computer Systems Centre (ICSC) at the University of the West of England (UWE) was founded in 1986 as a technology transfer unit of the then Bristol Polytechnic. ICSC's mission can be stated as being:

> *"to transfer technology into industry through collaborative projects and to develop an international reputation in applied research".*

As a consequence of strong educational roots ICSC is well placed to exploit training, support and consultancy activities arising from the PUPPIES project. Apart from PUPPIES specific opportunities in training and support, it is hoped that ICSC will be able to strengthen its consultancy activities in ODP and distributed database technology, as well as eventually develop a product based on the PUPPIES results. Dissemination of project results via international conferences is another important aspect of ICSC's activities and PUPPIES results will be published where appropriate.

The Faculty of Computer Studies and Mathematics in the University has recently established a business unit to manage the commercial exploitation of projects. The results from the PUPPIES project will become managed by this unit on completion of the project.