Follow Me

Part Two

Proposal

Mobile personal information spaces

"Freeing the user from the fixed desk-top"

Proposal under sections 1.24, 1.9 and 1.7 of the RITD Framework IV Workplan
by
APM Ltd, Cambridge, England
FAST GmbH, Munich, Germany
France Telecom (CNET), Paris, France
IRISA, Rennes, France

December 1996

For further information about this proposal please contact the project coordinator:
Mr W.A. Gibson, APM Ltd, Poseidon House, Castle Park, Cambridge CB3 0RD, UK
Tel: +44 1223 515010
Fax: +44 1223 359779
Email: wag@ansa.co.uk
URL: http://www.ansa.co.uk

CONTENTS

1. INTRODUCTION

1.1 OBJECTIVES

The desktop, be it Windows, Netscape, Explorer or some other, is the accepted way of accessing information systems. A significant weakness is that the user's desktop is tied to a machine and often to a single physical location. And yet users move around - within a building, a campus, a country, and across the world - and when they do they are mostly out of contact with what is now their principal working tool. There is a market need to give them easy-to-use access to their desktop wherever they are and on whatever technology is either appropriate or available at the time and place - for example a portable PC, a Psion-type organiser, a GSM phone, a pager, a "guest" PC, a PC belonging to some other individual in another company or department.

Fuelled by the Java revolution, mobile object technology and agent technology can be used to develop a virtual desktop. There are, however, considerable technical challenges to be overcome beyond what the project partners can fund as part of normal product R&D,

The market need for mobile information delivery is established; market intelligence suggests that the large industry players such as Microsoft do not plan to address this niche. MicroSoft's focus is *personal user productivity at the Microsoft desk top*; a focus which contrasts with the mobile user's need for *personal productivity across the network*. It is in this latter market where there is commercial opportunity - for products, Internet services and consulting. Through the FollowMe project the project partners aim to seize this opportunity.

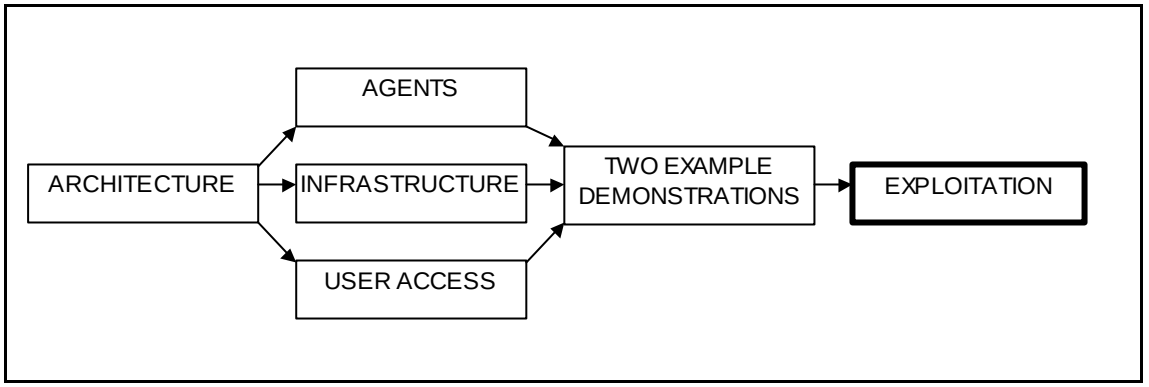
The objectives of the project are:

- to understand the needs of mobile users over a global network, with particular emphasis upon platform independence, away from the "home" desktop
- to develop an architecture for mobile desktop agents that follows users, allowing access to information via a variety of devices and platforms from different locations, making strong use of intelligent agent technology and showing how the architecture can be used to move the desktop-based user to a new, mobile paradigm
- to demonstrate a software prototype of the infrastructure system
- to construct two example industry-relevant applications
- to validate the model with European and global end user contacts. The project partners *already* have a particularly rich set of such contacts (such as Swiss Bank, Bavarian Ministry of the Interior, BMW, Sheraton Hotels, Ouest-France, Eurocontrol) and the consortium has been structured with this in mind.
- to make widely and freely available the prototype software ("Seedware") by delivering it free to universities and other research organisations and by its input to appropriate standards bodies (such as OMG and TINA).

The project responds to a vision of the Information Society as one of giving people and businesses universal access to a wide range of information resources, from any place at any time and, most importantly, the ability to delegate much of the management and interpretation of that information to a network-based infrastructure. This requires different architectures from those we have today for networked applications (e.g., client-server computing) and for applications integration (e.g., Active/X, CORBA). The project contains an exciting blend companies with expertise in agent-based computing, distributed computing architecture and networked applications tools. The project will bring significant benefits to the partners and enable European companies to take a lead in defining one of the most important next steps in the evolution of the Information Society.

1.2 RESULTS

The five principal results are illustrated in the figure below:



1.2.1 An architecture for a mobile desktop

The architecture will define the infrastructure and the structure of the mobile desktop agents. It will comprise:

- a set of design principles for mobile agents and the mobile desktop
- a framework for technical choices between different components
- component interface specifications
- implementation guidelines.

The architecture will build on the Reference Model for Open Distributed processing (ISO 10746 RM-ODP) which was developed in the Esprit ISA Project and which is a well-defined, proven industry standard.

Issues which will be addressed include -

- what infrastructure is necessary to allow the use of mobile agents
- process-driven rather than data-driven view of use tasks, focused on goals and objectives
- how mobile agents will allow operations such as -
    - a pre-scheduled move to another location
    - an unplanned move to another location
    - authorisation for device use - security issues for mobile information and code
    - using media-rich information over low bandwidth or ‘ small’ devices, including intelligent translation of information types
- information naming within the FollowMe environment
- collaboration between agents in the FollowMe environment.

1.2.2 The infrastructure software prototype

This prototype will provide a prototype working system. Lessons learnt at the prototyping stage will feed back into the architecture. It will demonstrate:

- information access from different locations
- information access from different devices
- control and exploitation of intelligent agents
- collaboration with other systems within the infrastructure
- core components (e.g. for locating objects)
- optional components for specific application styles.

1.2.3 Demonstration applications

Two demonstration applications will be designed and built to work within the FollowMe environment. The proposed applications have been selected by the consortium members as a result of discussions with their end-user business clients (Ouest France, for example). Thus they represent real user needs.

The market is a dynamic one and the project partners wish to reserve the right to review these continuously as the project proceeds and modify or develop them as their business clients may advise, such changes always

being made with the approval of the project' s external reviewers and the EU Project Officer. The development of the infrastructure prototype will also influence the final definition demonstration.

Application 1 - Etel++

Etel is a project currently being run by TC Multimedia, in association with INRIA, to provide users access via ISDN networks to an electronic version of the *Ouest France* newspaper. Etel++ will extend this project, allowing users to access the newspaper via the Internet, viewing information of interest to them from a wider variety of locations and devices. This will be achieved by dynamic customisation of user profiles, taking into account:

- the location of ETEL users,
- the management of user accesses from a variety of location using diverse access points,
- the use of the agent technology including the management of agent co-operation,
- the management of data access integrating mobility aspects.

Application 2 - User profiles for Bavaria online

Bavaria Online, whose Internet Service Provider is IZB, currently offers a wide range of services, from freight logistics to financial services, share dealing to health information. Many of these services are, however, static, and the aim of the second demonstration application is to extend some of these services to allow them to interact with user profiles to provide customised services. Creating an infrastructure in which the profiles can interact with the services, the system will allow better service at both the service and demand ends of the supply chain.

1.2.4 Seedware, standards and open dissemination

Seedware is software whose function is to encourage take-up, experimenting and generation of additional software by outside developers and which is made publicly available to this end. In the Internet world it is also a powerful means of creating emergent standards by allowing developers to create applications on proven models. Our seedware will be made publicly available through the Web, in particular to universities and other research facilities. APM Ltd has particularly good experience of this from the ISA Project, where one of the deliverables ("ANSAware") was taken up by 85 universities and similar bodies across the world. Open standards for mobile agents are one of the key missing ingredients to the success of electronic commerce, to many other aspects of mobile computing and to information use within a global network. The inputs to standards that will be made by this project will assist many different industry sectors to leverage the technology.

1.2.5 ActiveX, Explorer, Netscape, Windows 95, NT and other existing systems

The FollowMe software will:

- use ActiveX as the link to the Microsoft desk top
- use the Netscape and Explorer browsers as the standard conventional desk top browsers
- be built using Java as the "platformless" environment
- run on Windows NT and Windows 95
- provide self-configuring links to television, telephones, GSM phones, pagers, Psion-type organisers.

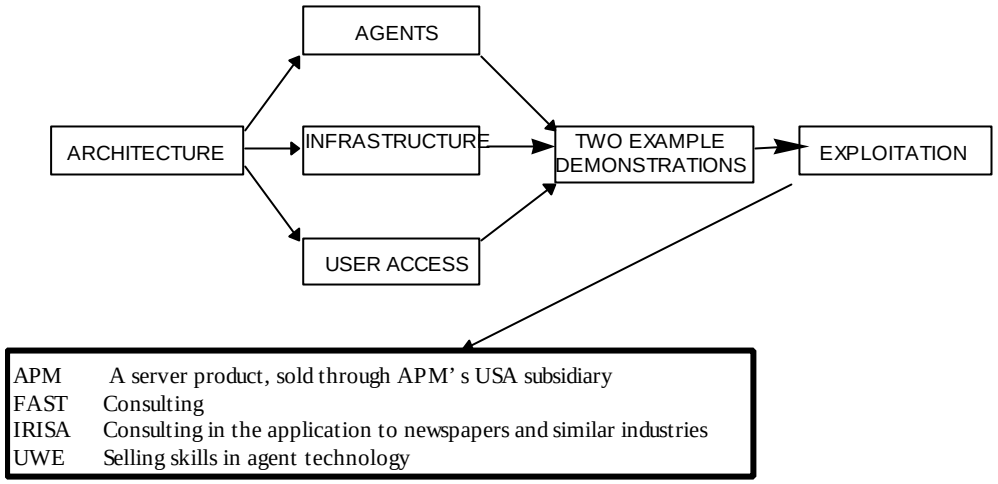
The agents will automatically adapt the desk top to the "device at the end of the wire".

1.2.6 What we will not do

- Develop a rival to Netscape, Explorer, ActiveX or Java.
- Demonstrate the desk top adapting itself to every possible scenario and every possible device - *based on advice from our existing business clients we shall select key examples and by the seedware we shall encourage others to add to this.*

1.3 EXPLOITATION PLAN

The goal of the project partners is commercial exploitation. The principal exploitation focus of each partners is shown below:



Competitive advantage has two parts. First, each partner can benefit individually from FollowMe by using its results in its business, with the focus indicated in the above diagram. Also by its use in internal and external projects. The dissemination of the seedware among universities, research foundations and within the IT community, together with the input to standards, will raise awareness of the companies and their skills in this area and create demand for its products and services.

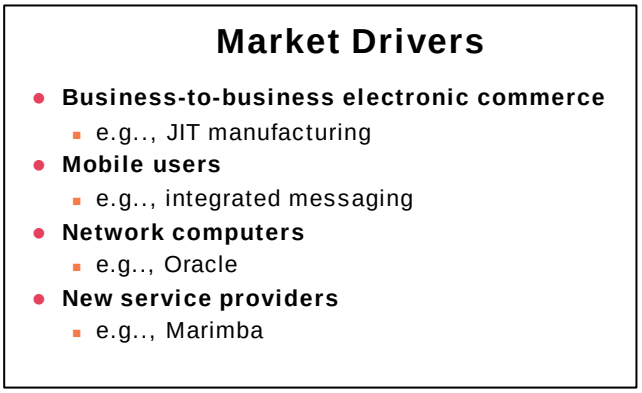
Second, the consortium expects that the whole will be greater than the sum of its parts - that within the FollowMe project, consortium members will continue to build strong working relationships, and, beyond the FollowMe project, will be able to plan joint projects and products exploiting the expertise gained, with shared knowledge and complementary skills. This model is of increasing importance in today' s marketplace.

Consideration of risks and potential problems for the FollowMe project, and therefore to the exploitation of its results, has led to the specific development and implementation strategy. The key element is the decision to build demonstration applications which:

- are practical examples gained from our existing business clients
- try out ideas and gather feedback from the contacts already held by consortium members
- contact new end users through these contacts and the Internet, securing markets for further exploitation.

1.3.1 Industrial relevance

We see four key drivers for the project. From the world of electronic commerce we detect a growing awareness that "business-to-business" transactions will rapidly follow on from the currently emerging "(human) customer-to-business" systems and that these business-too business systems will automate important business processes - for example negotiating re-order levels and prices for parts in Just-in-Time manufacturing. This will bring an emphasis to task-oriented help for the user and bring a temporal aspect to the desktop.



In the field of communications there is a pressing need for integration of the many forms of messaging by which a people can keep in contact with another - email, voice-mail, GSM Short Message Service. It should be possible for my SMS to advise me of an important email and be able to ring up and have that mail read out to me. Moreover it should be possible for me to use the same infrastructure to command important applications that support my electronic life.

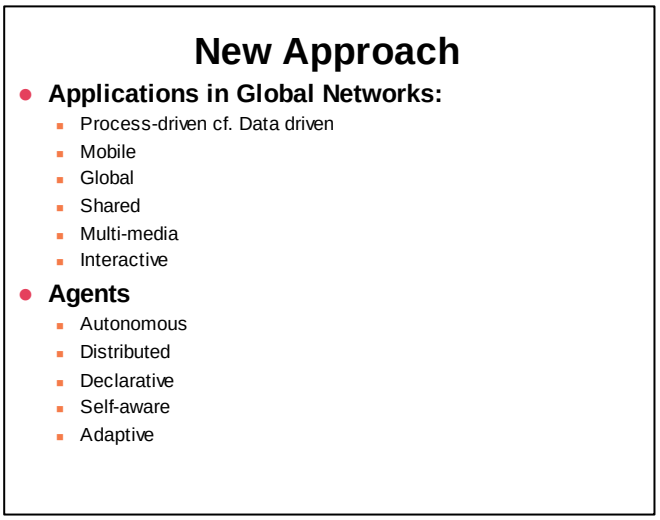
Network computers are an exciting innovation providing an opportunity for new service providers (and their technology suppliers - e.g., Marimba) to download services to users in a business and to provide management of those services for the business. We see the network computer not just as an "Internet terminal" but also as the user' s customised device for participating in collaborative tasks and acting as the user' s "virtual secretary".

FollowMe will provide a solid base, supported by Seedware and public specifications, for developing mobile agents and the means by which to control them and will demonstrate their use in two industrial applications which have been suggested by the partners' existing businesses.

Current approaches to the issues of mobility, user collaboration and mobile agents are fragmented, and there exists no overview to marry all the concepts into a workable system. These issues have tended to have been tackled separately, although once posited, the opportunities presented by a clear infrastructure and design methodology over these areas are clear.

All of the market drivers described above emphasise a transition in information processing away from the current data-centric models implicit in client-server styles of computing to a process- and server-centric approach. Moreover these processes are potentially mobile like the users they support, global in scope, shared between communities of users, interactive and rich in multi-media capabilities.

The systems model is one of autonomous agents responsible for automating a task distributing themselves around the network in whatever configuration is required to support the user best. For example they may be supporting a "network desktop" metaphor for the user with several machines (e.g.. one at home, one in the office). They may be interacting with information providers to keep critical information up-to-date.

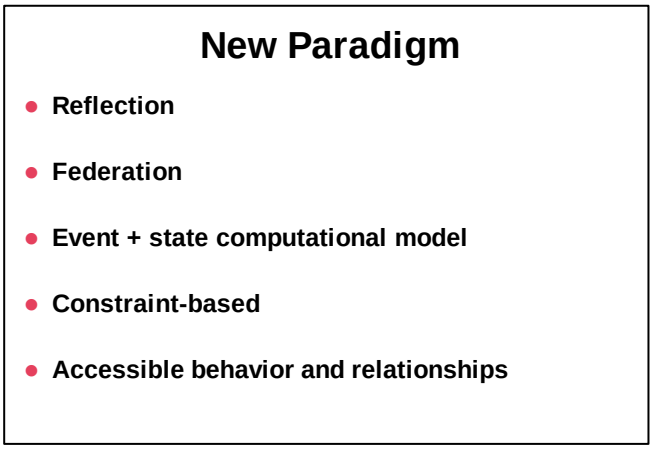


Mobile applications must adapt to the environment in which they find themselves and that environment will be under continuous evolution: therefore applications will necessarily be self-aware and adaptive so that they can operate effectively. This necessarily requires that in addition to the executable code of the agents, it must be possible to access a rich understanding of their behaviour and the relationships between agents.

Writing distributed software, even with a clean architecture, is hard. Increasing use will be made of declarative techniques by which the developer can nominate properties agents should have (e.g., persistence, a certain security policy) without having to spell out in detail how that property is implemented.

This new approach sets the project a challenge to harvest, integrate and expand upon several critical advanced technologies in innovative ways:

- Adaptability and flexibility can be achieved by the use of "reflective" programming techniques to make applications independent of their environment.
- Co-operation and autonomous distribution can be achieved by using the concept of federation from ANSA/ODP - using trading as a means to describe and solicit information about available services.
- The trading metaphor however needs to be greatly expanded so that descriptions of applications behaviour and relationships between applications can be used in place of simple descriptive names to enable evolution and adaptation.
- Moving to a declarative approach implies that agents are defined in terms of constraint satisfaction and rules. This in turn requires that the distributed infrastructure as a whole be able to signal "events" to interested agents and for those agents to be able to query one another and the infrastructure to decide how to respond.



The FollowMe project will provide an architecture, supported by a real, working infrastructure which runs on and works with the principal platforms in the marketplace (Netscape, Explorer, NT, W95, ActiveX) and two design examples. Industrial applications taking advantage of the results of the FollowMe project will allow developers,

service providers (who will host information), other service providers (who will provide it) to create first-phase benefits, and the productivity gains provided by the applications will benefit end users.

1.3.2 Standards

The commitment to be compatible and work with the products which are the *de facto* standards has already been covered in this proposal.
If there are areas of weakness in these products the consortium has the strength and experience to raise them in the appropriate forum.
Standards for agents are not yet well established and the project partners are committed to contributing to the process by which they will be defined. APM, for example, has long experience of inputting to and influencing standards bodies and has excellent links to:

- Object Management Group
- World Wide Web Consortium
- The Open Group
- ISO and IT SU
- IEEE
- Workflow Management Coalition.

In addition to specifications it is important that the project produce "seedware" that can be used by other projects as the foundation for developing additional functions and trials in other fields. By seedware we intend the widespread concept found today in the Internet of providing basic reference versions of core technologies within a licensing framework that makes the technology widely available, yet retains architectural control. The architecture will be positioned as an open solution to ensure as great as possible integration with and acceptability to other standards (e.g., OMG CORBA facilities, Java APIs, W3C proposals).

The publication of specifications and the free availability of seedware are important means of achieving these inputs and influences. They will allow developers to follow *de facto* standards, creating applications on a stable base. The specifications evolving from the architecture and infrastructure prototype will be published, backed up by appropriate White Papers. Through the Web, we shall encourage open forum comment and debate upon them, with the aim of contributing to the consensus process which is the basis of any standard.

APM will 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. 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.

1.3.3 APM

1.3.3.1 The competitive context

APM Ltd has a very strong position in the field of distributed systems and network architectures research and development, through its leading of the ANSA research programme, consultancy and development work.

In the last six months it has made a significant expansion to this base business by raising funds to enable it to expand into software products, establishing a subsidiary company in the Bay Area of California where the product sales, marketing and support will be focused. The product development plan includes Java applet (and other mobile object) security, securing transactions and, in a 18-24 months timescale, server software for the support of "virtual corporations" - the transient alliances which form an increasing feature in today's business. The business plans have attracted a great deal of "private" investment funds but of equal importance is the interest, approval and support from Intel Corporation.

APM will maintain its competitive edge by continuing its shared, industrially funded research programmes (ANSA and Object Lab) and, in addition to developing a product business and its strategy is to expand its consulting business five-fold in the next two years.

1.3.3.2 Relevance of the project results to APM's strategies

The mobile agent technology described in this proposal will:

- form a key part of the VC server product, enabling it to have enhanced capabilities and accelerating its deployment in the market by some 9 months
- enable the company's consulting arm to gain important contracts with clients who are looking for the class of solutions enabled by this project
- be delivered to the ANSA sponsors as part of the work within the ANSA programme.

An assessment of the commercial value of the project is given by the fact that the ANSA sponsors, which include ICL, Fujitsu-UK, Eurocontrol, Telefonica, France Telecom, Bellcore, GEC, GPT and the MoD, have agreed to contribute part of APM's costs.

1.3.3.3 Impact of the investment in FollowMe

The investment of APM in this project is some 1MECU, half of which is provided by the Commission. The benefit to APM's research programme is to attract new members. We estimate that we will attract two new members for five years. With all ANSA members there is spin-off consultancy which brings extra revenue. The estimate is:

- research and consulting additional revenue $0.68M

The benefit to APM's consultancy business is new contracts, we estimate that we shall gain at least five new clients, who will stay with us for at least two years. We have two clients who have already indicated that they need this technology. From previous client experience the income is estimated at:

- existing clients $1.2M
- new clients $0.7M

The largest benefit is from product sales. The VC server sales are estimated at $43M over three years. The project will accelerate the introduction of this product into the market and increase its acceptability. We estimate that the revenue benefit will be some £24M. Thus the total benefit to APM is $27M for a spend of $1M including an EC spend of $0.5M. We consider this to be an excellent return on investment.

Market Sizing

	Quantity	Value	Shipping at
Installed Server base	1M	$50 B	300k pA
Installed Corp. pc base	100M	$ N B	> 2M PA
Intranets	5-10k	$? B	+30% PA

Market Share targets

Planned sales by year 2000

Server market	47k units out of 200k	=	25%
Corporate PC's	700k units out of >30M	=	5%
Intranets	5K Units out of 20K	=	25%

1.3.4 FAST

1.3.4.1 The Competitive Context

FAST e.V. is a Bavarian research institute meant to support its members (Bayerisches Wirtschaftsministerium, Bayerische Landesbank, BMW, Siemens, Softlab and IXTRA) and the Bavarian software industry in general. As such FAST has established close links to research institutes at universities and applies the results directly within the organisations of its members or promotes the results publicly for the industry in Bavaria.
The impact FAST has in promoting and transfering new technology into the industry can be seen by its publications in the "Süddeutsche Zeitung" , by the publication of the serie "Die FAST-Reihe, Tectum-Verlag", by the regular public events "Wirtschaftsgespräche im Bayerisch Hof" and by its major role in the setting-up the concept and managing the realisation of "Bayern Online" (http://www.bayern.de/BayernOnline). In the latter FAST is actively engaged in promoting the use of the internet in the day to day business of the small and medium sized industries in Bavaria.
Distribution, teleworking and business reorganisations and Internet are and will be major issues for the years to come.

1.3.4.2 Relevance of the project results to FAST's strategies

Since FollowMe tries to exploit globally distributed networks and provides new areas of application of the internet it fits perfectly into the mission of FAST to transfer technology and research results into practical use.

In that sense FollowMe is a straight continuation of the earlier work of employees of FAST, such as the development of the European Modelling Language (EML) within ASSET, the development of Euromethod and an early guide on distributed systems developed between CCTA, Model Systems and Siemens Nixdorf.
The prototypes and results from FollowMe could be instantly employed in a variety of projects within the member organisations and within the framework of "Bayern Online".
FollowMe is also relevant for FAST itself, as most consultancy activities imply travel and the need of remote or mobile access to information.

1.3.4.3 Impact of the investment in PUPPIES

The investment of FAST in this project amounts to 59 person months over a period of two years. Half of the cost are funded by the Commission.
FAST currently has 7 members which provide FAST with a membership fee of 100 TDM/year. In addition the members contract the resources from FAST to perform projects within their organisation. In those projects FAST does not only act as a consultant but is also transferring its know-how into the customer organisation. FAST has estimates to attract 2 new members in the '98 and another 2 in the following year. The new memberships will generate a net income which amounts to 600 TDM in the course of the next 3 years.
New membership usually goes hand in hand with new consultancy opportunities. The business plans of FAST for the next 3 years in this area are one consultant full time for next year and 2 consultants in the following year. This gives rise to an increased business of roughly 650 TDM.

1.3.5 INRIA - IRISA, Rennes (France)

IRISA is a public research laboratory comprised of two units : the INRIA-Rennes research unit and a research unit (URA 227 CNRS) in which CNRS is associated with the University of Rennes I and INSA of Rennes. There are about 250 people at IRISA : researchers, engineers, technicians, management and PhD students. IRISA is developing its research activities in the context of fast technological evolution and fierce scientific and industrial competition. The research undertaken by IRISA therefore has to be of the highest quality, and the transfer of the results of that research to industry are very important. Research spans a wide range of activities from the development of hardware components to the implementation of advanced applications. Parallelism is a key concept being studied in circuit and novel architecture design. The building of distributed (or parallel) systems hiding complex hardware resources and yet providing a simple view of the system for its users has produced original ideas in the field of fault tolerant multiprocessor systems. It is also necessary to provide the users of such machines with secure and powerful programming tools. Recently, a programming environment for real-time applications has been developed as well as a new logic programming formalism and an object-oriented language for system programming.
The Solidor group, led by Michel Banâtre, has a staff of 20 persons and works in the following areas : component-based programming for the development of distributed services, support for multimedia applications, parallel programming environment on distributed services, support for multimedia applications, parallel programming environment on distributed systems, and fault-tolerant systems. One of the goals in the Solidor group is to evaluate research results in the domain of distributed systems by applying these results to industrial applications.

1.3.5.1 Relevance of the project results to INRIA's strategies

The expertise gained from participation in the FollowMe project will have an important impact on INRIA' s continuing research into distributed systems, in particular the provision of a simple, transparent view of the FollowMe infrastructure to the user. INRIA' s involvement in the design and implementation of the Etel++ demonstration application will allow further research into an area which is already of great importance to the research being carried out, consolidating links with current industrial partners and maintaining a strong lead in this area of research.

1.3.6 TC Multimédia in Rennes (France)

1.3.6.1 The Competitive Context

TC Multimédia is the multimedia and telematic subsidiary of Sofi-Ouest within the group Ouest-France, the most widely distributed newspaper in France since 1976 at 800,000 copies daily.

TC Multimédia, a firm composed of 17 engineers and technicians, is specialized in providing on-line services and their conception (notably Ouest-France's on-line service), as well as the production of telematic services associated with the newspaper (tax calculation services, or even the collection and treatment of exam results that are both posted on minitel and published in the paper). TC Multimédia also produces a wide range of software packages for the tourism industry, bringing its know-how fully into play in the field of telematics and ticket reservation management. Its software packages range anywhere from tourist bureau reception and management products, to central reservation hubs and availability databases in the hotel industry and furnished rental industry.

TC Multimedia has also been heading up Ouest France's future electronic newspaper project, Etel, since 1995. This three-year project, in collaboration with the IRISA (l'Institut de Recherche Informatique et Systèmes Aléatoires), is spearheading the elaboration of an extremely high-quality electronic press service which will enable end-users to directly access Ouest-France's 40 editions, 400 pages, and 1,500 photos daily. The electronic version of the newspaper will retain the identity of the print version, but will be multimedia enriched (sound and images), and enable end-users to put together their very own "daily me".

1.3.6.2 Relevance of the project results to TC Multimédia's strategies

In 6 months' time, TC Multimédia will become a part of Ouest France, a move which highlights the importance of the Etel project. The Etel project is currently based on ISDN networks, but the intention is to move it to the Internet, allowing access by more people over a less-restricted user base. One of the two pilot applications in the FollowMe project will use Etel as a starting point, and the knowledge gained, as well the links with other partners, will have a large impact on the project and its future on the Internet.

1.3.7 IZB and Bavaria Online

1.3.7.1 The Competitive Context

The Informatik Zentrum Bayern used to be the computing centre of the Bayerischen Landesbank and the central bookkeeping system for all Bavarian Sparkassen. When it was founded its main task was to operate a network between all locations and the central provision of computing power. However, it soon had to provide other services in addition like the central security system, a corporate network, a client-server network and distributed data bases, electronic mailing system etc., and has now the biggest private network operating in Germany.

As the prime partner for the Bayerischen Landesbank and all Sparkassen it was a natural candidate for providing the network infrastructure for the Bavarian Online Project.

1.3.7.2 Relevance of the project results to IZB's strategies

The economic strength of a location depends, in addition to the efficiency of the people living there, primarily on how well it is connected to other places. Telecommunication allows commercial users to achieve large efficiency gains and brings significant improvements in the quality of life of private users.

Through a introducing new technologies in Bavaria to strengthen local industry and to connect additional companies from the added value chain (networks, contents, terminals, hardware, software, and all sorts of sector-related consultancy services), additional export possibilities, jobs and tax revenue will result.

Many users have an interest in the higher value telecommunication applications, and are frustrated that an adequate and wide range of services offered does not exist. This in turn has its origin in the current limited demand, also to be expected during an extension of offered services, which can sustain no cost-covering and absolutely no profitable offer; a vicious circle which must be broken.
To maintain and build on Bavaria's top position as an economic location, the aim of the initiative of the Bavarian government is to accelerate the use of modern telecommunication methods in Bavaria. Analysis has shown that for this three impediments must be removed:

- the deficient knowledge about the possibilities of communications;
- the low number of suppliers with extensive products and services in terms of telecommunication services and applications;
- the unattractive cost situation for telecommunication services.

The FollowMe project will enable IZB to address all three of these effectively.

1.3.8 ICSC - UWE

ICSC is a department of the Faculty of Computer Studies and Mathematics at University of the West of England devoted entirely to industrial consultancy, collaborative projects and advanced training. ICSC was founded in 1989 with a mission to transfer technology into industry through collaborative projects and to develop an international reputation in applied research..

ICSC specialises in decision support systems and distributed architectures to implement decision support systems and brings the following expertise to the project:

- Distributed Architectures; Open Distributed Processing (ODP) and implementation using the Common Object Request Broker Architecture (CORBA) from the Object Management Group (OMG)
- Agent Systems; combining machine learning approaches with distributed architectures
- Machine Learning; strengths in Genetic Algorithms, Evolutionary Computing, Neural Networks, Case Based Reasoning

This expertise has been built up through a strategic programme of basic research which has underpinned a number of collaborative projects with industry and those which are directly relevant to the project are

TRENDS (EU ESPRIT Trial Application 20791) . The project is a trial deployment of a real-time fault tolerant distributed system for providing traffic information. The project is designed to demonstrate the advantages of using distributed object technology based on emerging standards from the Object Management Group (OMG) and to use the Internet for delivery of services to end users. The project started in January 1995 and is of two year duration.

The project "Evolving Agents for Multi-Agent Systems" is funded by Hewlett-Packard Ltd. This project examines the use of evolutionary computing techniques in multi-agent systems for distributed control and resource allocation. Using genetic algorithms systems have been built which allow for dynamic agent allocation and remove the traditional requirement for formal descriptions of a system.

EvoNet (EU) is the Network of Excellence for Evolutionary Computing. ICSC at UWE is the Co-ordinator for this Network which aims to enhance the use of these techniques in industrial situations.

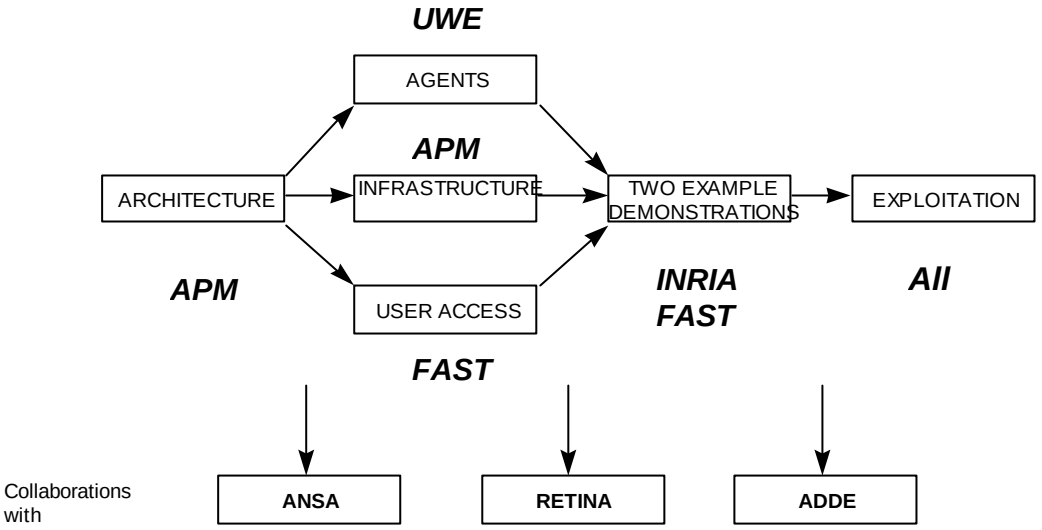
HPPC-SEA (EU1063) is a Eureka project. The ICSC contribution is to build a decision support system for financial applications based upon evolutionary computing techniques and knowledge-based systems.

1.3.8.1 Relevance of the project results to ICSC's strategies

As a consequence of strong educational roots the Intelligent Computer Systems Centre (ICSC), which is part of the University of the West of England, is well placed to exploit training, support and consultancy activities arising from the FollowMe project. As a result of participating in the FollowMe project ICSC intends further to develop its training course activity in object technology based on the OMG CORBA standard project and to consolidate its industrially funded research into adaptive agents. ICSC has departmental status within the Faculty of Computer Studies and Mathematics and is currently engaged in establishing a Faculty-wide business unit. The business unit will be actively seeking to exploit the results of the FollowMe project.

1.4 PARTNER ROLES

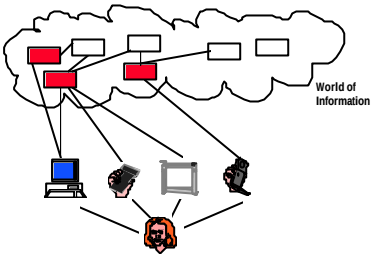
The principal leadership roles of each project partner are in the following diagram, which also shows the links to other Esprit projects with which the FollowMe project plans to work closely.



2. PROBLEM SPACE

The following presentation slides provide an overview description of the projects requirements and goals.

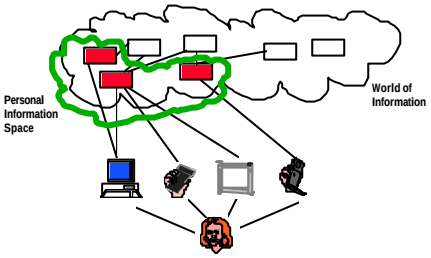
1 - Mobile users - global information



2 - The risk of overload

- Dispersed information
- The user is mobile
  - Needs access to that information
  - Needs the information to be managed
- User has many points of access
- User may not wish to carry an appliance or laptop

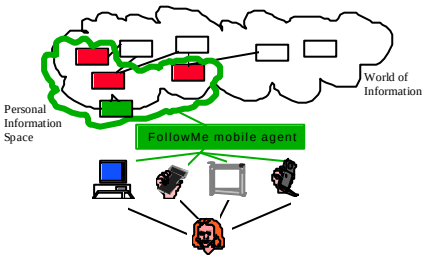
3 - A Personal Information Space



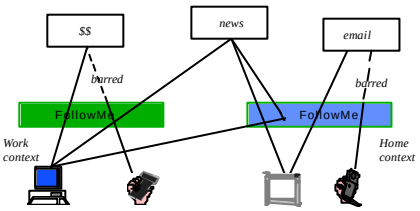
4 - A Personal Information Space

- A Personal Information Space
  - A conceptual 'home' for information
  - Managed for ease of use
- Accessible by the mobile user
- Accessible from a variety of access points & types
  - ...with recovery after disconnection

5 - FollowMe agents managing services



6 - FollowMe at work and play



7 - Research Topics

- Development of agent technology within object model
- Management of data, including mobility issues
- Information access models
- Context dependence
- Device negotiation

8 - The benefits

- Resource description techniques
- Location techniques
- Networked mobile desktop
- Object-oriented information services
- Federation of users' workspaces into "group spaces"

In this chapter we describe the current situation (state of the art) and explain what the impact or result of FollowMe will be. The two positions (initial and final state) will give a measure of the effort needed within the FollowMe project.

2.1 MOBILE AGENTS, THE CURRENT SITUATION

The FollowMe project relies on two main technologies - (intelligent) agents and mobile computing. On top of these can be built CSC (Computer-supported collaboration) applications which make use of the agent and mobile

computing technologies [e.g. Williams & O' Brien 1995]. The two main leverage technologies are introduced below.

2.1.1 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 environmental 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 co-operative 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 developed 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 architectures 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 development of agents.

2.1.2 Mobile computing

The current user paradigm for computer and electronic information use revolves heavily around the concept of a "home" workstation which is accessed via the facilities of the desktop. This limits mobility and restricts interactions to the form supported by that media. In the "FollowMe" paradigm, a user's environment is located on a server-based network managed by a service provider. Access is obtained via device-independent procedures which transform the data to a form suitable for the particular interaction.

The most important difference between current systems and the FollowMe paradigm is that although current systems allow information to be moved from one place to another, or viewed remotely, the information processing power tends to reside in one place. Either that, or multiple copies of information will exist, causing versioning problems. Although Lotus Notes and similar applications allow some sharing of information sharing, mobility is badly catered for by current technology. In the FollowMe paradigm, the power to process the information is mobile with the user, as well as the information itself. This ability for users to process and make real *use* of information, wherever they are, using whatever devices they have available to them, allows them much more power than currently, as examined by Louis and Morrow [1995].

A number of resources are held by Lancaster University, UK, addressing the current status of mobile computing research and including a bibliography - see:

http://www.comp.lancs.ac.uk/computing/research/mpg/most/bibliography.html

In order to exploit the mobility and device independence, a user's environment is not simply a collection of references and data. By utilising a process-driven approach, the user is able to specify the objectives of their

tasks. This provides the framework for agent technology to satisfy goals either individually or in collaboration with other proxies. In addition, understanding the reason why information has been obtained facilitates in the presentation and allows it to be tailored for different access media.

2.2 INPUTS TO FollowMe (INITIAL STATE)

A wide range of technologies are emerging which will impact on FollowMe. Of key importance are the existing de facto industry standard platforms.
The FollowMe software will:

- use ActiveX as the link to the Microsoft desk top
- use the Netscape and Explorer browsers as the standard conventional desk top browsers
- be built using Java as the "platformless" environment
- run on Windows NT and Windows 95
- provide self-configuring links to television, telephones, GSM phones, pagers, Psion-type organisers.

Three technologies which have been or are being developed by the partners are expected to be of particular importance:

- **ADDE** - (Application Development for Distributed Enterprise) - a European project to investigate distributed application development
- **ANSA** - an open, collaborative programme in research and advanced development in distributed and networked systems
- **Java -** a device-independent object-oriented programming language.

ADDE
ADDE is a current project funded by the European commission (Technical Annex available at http://www.fast.de/ADDE) to address issues in Application Development for Distributed Enterprise (ADDE). Among its aims are:

- to develop guidance for the design of distributed application systems, driven by the business requirements of distributed enterprises.
- to address coherent designs that use network-based technologies such as groupware and Inter/intranet as well as database transaction processing, in anticipation that the technologies will converge over the next few years.
- to demonstrate how the general approach can be used to extend IS development methodologies. It will use UML (being developed by Booch, Jacobson and Rumbaugh) for its primary demonstration, but also take account of established IS methodologies such as BOS-Engineering, MERISE, Q-MEIN, SEtec and SSADM
- to construct a repository for the specification and design products needed for distributed systems, capable of supporting multiple IS development methodologies via interfaces to development tools

All these aspects of ADDE have clear bearing on FollowMe, and it is expected that the results of ADDE will be extremely relevant to the project.

ANSA
The ANSA programme, managed and operated by APM Ltd is currently in its third phase. The first two phases, now complete, focused on methods for building distributed systems from multi-vendor, cross-domain, heterogeneous individual processing systems. APM' s part in the ANSA programme provides a useful technical base, and the involvement of the ANSA sponsors provides a solid user base for analysis of user need, prototype testing and feedback.

Java
Java is a simple, robust, object-oriented, platform-independent multi-threaded, dynamic general-purpose programming environment. The fact that it is platform-independent and network-aware allows development of software that is easy to transport between devices and which can be utilised in many environments. The current interest within both the software and hardware parts of the industry is leading to a rapid uptake of Java technology. There is a large and lively user community, making it a good choice of language in which to provide Seedware, and from which to seek feedback.

2.3 USER NEEDS AND SCENARIOS

2.3.1 Users

The existing user needs have been determined in broad terms from:

- discussions with business clients of IRISA, APM and FAST
- project work in the field by UWE
- user needs from TC Multimedia and IZB

The following users will continue to be consulted and "experimented upon" during the project. All are existing clients of the companies indicated, there is no "user group" which needs to be formed.

APM	MoD
	Swiss Bank-Warburgs
	The ANSA sponsor group (which includes ICL, Fujitsu-UK, Eurocontrol, Telefonica, France Telecom, Bellcore, GEC, GPT and the MoD)
FAST	Union Bank of Switzerland
	Landis and Gyr
	Douane Francais
	John Lewis Partnership
	Sheraton Hotels
	Bavaria Online via IZB
IRISA	Ouest France via TC Multimedia
UWE	Lloyds/TSB

2.3.2 Scenarios

From discussions with the users the following scenarios have been developed. These will provide input to the choice of demonstrator. In this proposal they provide a valuable overview of the user requirements which have driven the project proposal so far.

Scenario 1 - Today's news - wherever I am

I have a range of interests and like to keep in touch with news. My personal mobile agent 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 mobile agent 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 mobile agent knows that I access information from a range of devices, and over time can learn my preferred access method in different situations. The mobile agent 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 mobile agent 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 mobile agent is aware of what formats are acceptable for which access-methods, and presents the information accordingly.

Extended Scenario

Using access to my diary to determine where I am likely to be over the week, my mobile agent 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 mobile agent 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 mobile agent 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.

Scenario 2 - Meeting arranger

My mobile agent 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' mobile agent, which represents us. This mobile agent 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 mobile agent representing these people negotiate with our federated mobile agent to arrange a time. The mobile agent does this and arranges for my personal mobile agent to update my diary.

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 mobile agent wishes to get in touch with me, and contacts my personal mobile agent. My personal mobile agent 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 mobile agent my numbers. The federated mobile agent phones me up and asks me whether I can make the time or not. I give the mobile agent my answer 'Yes', interpreted using either touch-tone dialling or a voice-recognition system, and the mobile agent books the meeting.
The mobile agent 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 mobile agent can order sandwiches for us, negotiating with our personal The mobile agent 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 mobile agent 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.

Scenario 3 - Worlds on your desktop

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 mobile agent in *Scenario 2* above, the company for which I work has a company mobile agent. Although my personal mobile agent does not have access to all details about the company, in the way that the mobile agent belonging to the company CEO might do, there is certain information about the state of the company that the company mobile agent can communicate to me via my personal mobile agent. For instance, one of the duties of the company mobile agent 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 mobile agent 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 the mobile agent - my team's mobile agent, for instance, may provide information about how well we are keeping to budget on our project.

Extended scenarios

As the information is being communicated to me via my personal mobile agent, my personal mobile agent 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. The method of display would be different for different displays - for instance, a device without a display might use sounds of a different pitch and volume to give information.
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 mobile agent may, in consultation with the team mobile agent, 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.

Scenario 4 - Shopping

My Mobile agent has access to a shopping agent. As my mobile agent 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.

Extended scenario

My mobile agent 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 The mobile agent to work together. This federated mobile agent 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 mobile agent 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!

Scenario 5 - Transport

I am making a journey which involves quite a long drive, and I wish to avoid traffic as much as possible. I tell my mobile agent where I want to go, and when and the mobile agent, using a route-planning agent, plans a route for me. Unlike most traditional route-planning methods, however, the agent that my mobile agent uses negotiates with a traffic control system to decide the best route. Also, as my mobile agent 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 mobile agent 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.

Extended scenario

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

2.3.3 References

Agre P & Chapman D (1987), "PENGI: An Implementation of a theory of activity", in Proceedings of the Sixth National Conference on Artificial Intelligence (AAAI-87), AAAI, Seattle, pp268-272.
Burmeister B & Sundermeyer K (1992), "Cooperative Problem Solving Guided by Intentions and Perception", in E Werner & Y Demazeau (ed.s) Decentralised AI 3, Elsevier, Berlin, pp77-92.
Cohen P R & Levesque H J (1990), "Intention is Choice with Commitment", Artificial Intelligence 42:213-261.
Fisher M (1994), "A Survey of Concurrent MetateM - the language and its applications", in D M Gabbay 7 H J Ohlbach (ed.s) Temporal Logic, Springer-Verlag, Berlin, pp480-505.
Jennings N R (1992), "On Being Responsible" in see Burmeister & Sundermeyer.
Louis D K & Morrow L A (1995), "The Prairie School: The Future of Workgroup Computing", in D Leebaert (ed) "The Future of Software", MIT Press, Cambridge Mass, pp. 105 - 126
Muller J P (1994), "A Conceptual Model for Agent Interaction", in S M Deen (ed.) Proceedings of the Second International Conference on Cooperating Knowledge-based Systems, University of Keele, Keele, pp213-234.
Vere S & Bickmore T (1990), "A Basic Agent", Computational Intelligence 6:41-60
White J E (1994), "TELESCRIPT technology: The Foundations for the Electronic Marketplace", White paper, General Magic Inc.
Williams D & O' Brien T (1995), "Software without Borders: Applications That Collaborate", in D Leebaert (ed) "The Future of Software", MIT Press, Cambridge Mass, pp. 127-156
Wood S (1993)(ed.), "Planning and Decision Making in Dynamic Domains", Ellis Horwood
Wooldridge M (1992), "The Logical Modelling of Computational Multi-Agent Systems, PhD Thesis, UMIST, Manchester.

2.4 DELIVERABLES (PROJECT OUTPUTS)

2.4.1 Report for publication

A report on the project and its results to be provided to the Commission for publication. An overview of the architecture and the major concepts modelled will be included.

2.4.2 Exploitation plan

An exploitation plan, to be provided to the Commission, examining, in broad terms, a plan for exploiting the results of the FollowMe project both by partners and by the industry at large.

2.4.3 Architecture

The architecture for the FollowMe comprising:

- a set of design principles for mobile agents and the mobile desktop
- a framework for technical choices between different components
- component interface specifications
- implementation guidelines.

2.4.4 Infrastructure prototype

The infrastructure prototype will provide a complete basic version of a FollowMe working system, implementing the architecture. It will create an infrastructure, software to run within the architecture, and simple applications for the mobile agents to control.

2.4.5 Demonstration applications

Two demonstration applications will be delivered -

- **Application 1 - Etel++**
- **Application 2 - User profiles for Bavaria online**

2.4.6 Exploitation: Seedware

Example software whose function is to encourage software generation by outside developers and which will be made publicly available to this end. It will be distributed specifically to universities and research institutes.

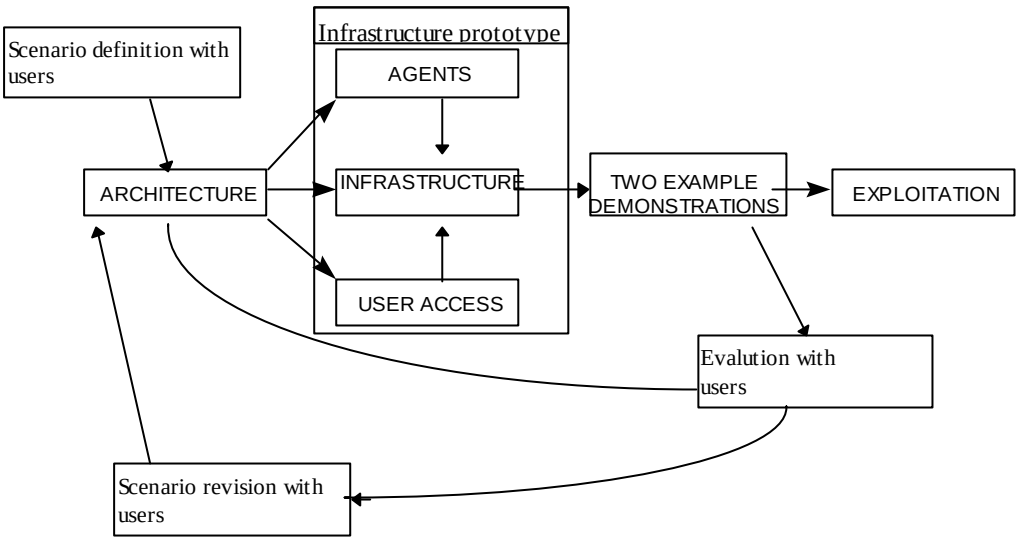
3. STRATEGY

The strategy for a project which is at the advanced edge of agent and distributed system technology has to:

- be experimental , flexible and evolutionary in the approach to what can be achieved
- be reactive to what is available in a fast moving marketplace and technological field
- be participatory, continually seeking out the opinions of end users with whom the partners have a good established relationship
- have frequent reviews of the plans and a willingness to adapt them as necessary
- have good, established and proven management of the project and consortium
- have an established and good working relationship between the partners.

3.1 DEVELOPMENT STRATEGY

The project development strategy is shown in the diagram:-



The users who will be involved have been indicated in a previous section of this proposal.

3.2 PROJECT MANAGEMENT

The project manager is the principal officer of the consortium and is appointed by the Project Management Committee. His responsibilities are defined in the consortium agreement and, in simple terms, are:

- project management of FollowMe, reporting to the Project Management Committee
- operational interfacing with the European Commission
- coordination between the partners.

The proposed Project Manager is Billy Gibson of APM, who has successfully led the Esprit Trends Project. APM will also provide the project office; it has long experience of managing Esprit projects including the highly successful ISA and the current and very important E2S project. Dr Gibson has wide industrial experience, including several years in Japan and the Far East with end-user companies in the financial market. Overall technical direction will be provided by APM's Chief Technical Officer, Dr Andrew Herbert, who is a world-acclaimed expert in distributed systems. Consulting advice on project operations will be provided by Michael Eyre.

Each workpackage will be led by one single partner, as indicated in the "principal roles" diagram in an earlier paragraph of this proposal.

Experience of ANSA, ISA, E2S, EML and other projects has shown that common understanding of goals and technologies is achieved most effectively by frequent joint workshops, which are technology driven and which are attended by all partners. The project will therefore hold frequent workshops, each of which will be chaired by an appropriate staff members of the company responsible for the workpackage into which it falls.

Demonstrator planning and the involvement of the users in commenting upon the trails will be guided by the project manager, with the partners performing their tasks individually.

Quality of results will be assured by:

- reviews of every deliverable by the Project Management Committee on which every partner is represented
- use of results by partners other than that which developed the results
- maintaining a single (distributed) database of results
- excellent communications by email, FTP and the Web.

Project plans may be amended by workpackage leaders, in consultation with the Project Manager provided they do not affect the overall plan or the key deliverables and milestones. The Project Manager will collect and collate updates to the plan and present these to the EC Project Officer along with cost claims statements, or at an earlier date should the changes become large in number. Changes which affect key deliverables and milestones will be reviewed and approved by the Project Management Committee, before submission to the EC Officer.

The Project Manager will define the acceptance criteria for deliverables, agree this with the Project Management Committee. These criteria are a deliverable in themselves.

3.3 CONTRACT CONTROL

The principal means of formal control of the project will be the key deliverables, defined in Section 4 of this proposal. The consortium agreement will define the rights, obligations and duties of partners and the procedures for resolving conflicts. This agreement will also define any background, foreground and IPR issues. The basic form of Consortium Agreement used will be that already developed by the Commission and used in projects such as ISA, Trends, E2S.

3.4 EC PROJECT REVIEWS

Progress will be reported to the Commission every three months by means of a formal progress report from the Project Manager, including a "project snapshot", effort figures and a formal progress reporting chart.

The Project Management Committee will also meet every three months, or more often if necessary at critical times in the project.

Commencing in the third month and every 9 months thereafter, there will be an External Review of the Project, carried out by external reviewers and the EC Project Officer. Completed deliverables, including project reports, a management report will be circulated to the reviewers at least three weeks before such a meeting. It is important that the reviewers, as well as the project partners, are connected to the project by email and FTP.

At the end of the project there will be a comprehensive final report, published as a booklet, which describes:

- the architecture
- the experience in using the architecture
- the demonstrations and their results
- lessons learned.

4. OBLIGATIONS AND RIGHTS OF PARTNERS

The obligations and rights of each partners are defined in the Consortium Agreement, a copy of which can be found on (web location).

4.1 IPR

Each member of the consortium will have rights to exploit the architecture and the Seedware. The demonstrations will be available for use by each partner as demonstrations of the viability of the architecture and the infrastructure. The deliverables will be of "robust prototype" quality and any industrialisation is at the expense of the partner undertaking it; industrialised version of the infrastructure and demonstrators will be the property of the companies which have carried out the industrialisation. These industrialised results will be made available to other partners, should they wish, on appropriate terms in line with the EC contract.

- The architecture, the specifications, the models and the Seedware will be made openly available via the Internet.

5. DELIVERY PLAN

The project naturally falls into 8 different areas of work. These reflect the design, the major components of the system, the pilot applications and the means by which the results will be exploited.

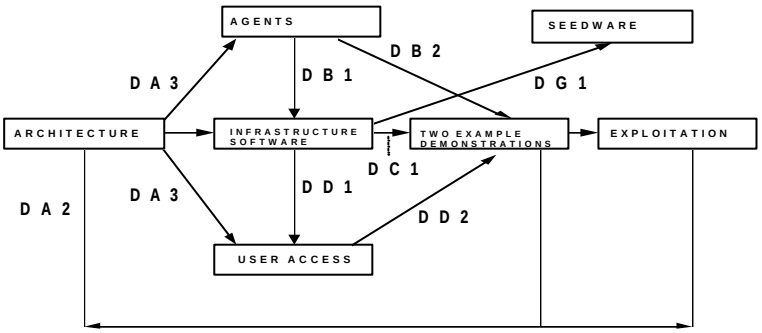
5.1 WORKPLAN

The work packages are listed below and described in more detail in the following sections.

WORK PACKAGES SUMMARY

WP	TITLE
A	Architecture & Design
B	Agents
C	Infrastructure
D	User Access
E	Pilot Application #1
F	Pilot Application #2
G	Exploitation/seedware
H	Project Management

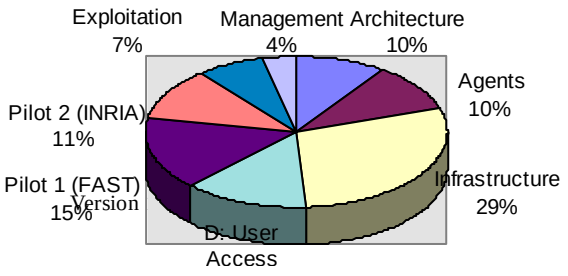
WORK PACKAGE INTERDEPENDENCE (showing key deliverables)



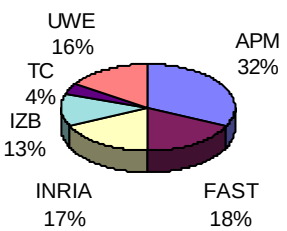
WORK PACKAGE EFFORT ALLOCATION

	APM	FAST	INRIA	IZB	TC	UWE	Months	Years
A: Architecture	21	1	7	1	1	1	32	2.67
B: Agents						33	33	2.75
C: Infrastructure	52		18	9		15	94	7.83
D: User Access	12	23		10			45	3.75
E: Pilot 1 (FAST)		32		18			50	4.17
F: Pilot 2 (INRIA)			29		8		37	3.08
G: Exploitation	8	3	3	3	3	3	23	1.92
H: Project Management	12						12	1.00
Months	105	59	57	41	12	52	326	27.17
Years	8.75	4.92	4.75	3.42	1.00	4.33	27.17	

EFFORT BY WORK PACKAGE



EFFORT BY PARTNER



WORK PACKAGE A: ARCHITECTURE & DESIGN

Summary

Work Package Leader:	APM
Effort:	26 Person months
Start:	Month 1
End:	Month 18
Partners Involved:	ALL

Objectives

The work in this package is separated into three stages. As the project has a heavy research focus, it is envisaged that collecting just user requirements would yield little benefit. The proposed approach is to augment user requirements with various scenarios derived by the consortium. This will be the input to derive the systems architecture.

The systems architecture is the second stage and will be the basis for overall design of the system. This architecture will describe the major systems components and their objectives. In addition, it will examine key issues which need to be addressed and specify a set of guidelines and procedures which will underpin the design.

The second stage of this work package is the overall system design. The framework architecture will be the basis of this work. The design will clearly specifying the role of the major components and the manner in which the interoperate.

Tasks

TASK	NAME	DESCRIPTION
A1	Scenarios	Collect user requirements and derive scenarios
A2	Architecture	Identify and specify overall system components
A3	Design	Develop overall implementation design

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
A1	Scenarios	2	1	1	1	1	1
A2	Architecture	13					
A3	Design	6					
	Total:	21	1	1	1	1	1

Outputs

DELIVERABLE	DESCRIPTION
DA1	Scenarios
DA2	Architecture Report
DA3	Overall System Design

WORK PACKAGE B: AGENTS

Summary

Work Package Leader:	UWE
Effort:	33 Person months
Start:	Month 3
End:	Month 13
Partners Involved:	UWE

Objectives

Agent technology will be used throughout the project in various roles. Instructions will be provided to these software devices via the specification of objectives. This will enable them to achieve tasks both independently and in collaboration with other bodies. Persistent agents will be used to hold information about a user, other shorted lived entities will achieve specific tasks and then terminate.

Tasks

TASK	NAME	DESCRIPTION
B1	Survey	Survey current Agent techniques and technologies
B2	Process Language	Design and specify a means of enabling objectives to be described
B3	Design	Develop design for mobile agents
B4	Infrastructure Requirements	Specify required infrastructure resources and facilities
B5	Interface Specification	Specify interfaces to agents
B6	Implementation	Create working version
B7	Tests	Perform component tests

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
B1	Survey						1
B2	Process Language						6
B3	Design						4
B4	Infrastructure Requirements						2
B5	Interface Specification						4
B6	Implementation						14
B7	Tests						2
	Total:						33

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design

Outputs

DELIVERABLE	DESCRIPTION
DB1	Infrastructure Requirements Report
DB2	Interface Specification Report
DB3	Working Version

WORK PACKAGE C: OBJECT INFRASTRUCTURE

Summary

Work Package Leader:	APM
Effort:	94 Person months
Start:	Month 5
End:	Month 12
Partners Involved:	APM, INRIA, IZB, UWE

Objectives

The purpose of the infrastructure is to provide the basic mechanisms for security, distribution, persistence and concurrency for objects. It enables other system components to operate without being aware of the location of the object they are utilising. Through a global naming service, objects are located and made available on request. Implementing the policy of moving and replicating objects as opposed to accessing them remotely is also the responsibility of the infrastructure.

Tasks

TASK	NAME	DESCRIPTION
C1	Requirements	Collect Requirements for infrastructure
C2	Design	Infrastructure design for security, location, persistence, and concurrency
C3	Interface Specification	Specify API for infrastructure components
C4	Location Service	Build global object locating service
C5	Basic Infrastructure	Build object encapsulations to legacy systems and network services
C6	Agent Infrastructure	Build support mechanisms for agent technology
C7	Mobility	Build infrastructure required to monitor and perform code mobility
C8	Tests	Component testing

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
C1	Requirements	2		2	2		2
C2	Design	3		3			
C3	Interface Specification	2		2			
C4	Location Service	9					
C5	Basic Infrastructure	10		10	2		
C6	Agent Infrastructure	12			2		12
C7	Mobility	12			2		
C8	Tests	2		1	1		1
	Total:	52		18	9		15

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design
DB1	Agents Infrastructure Requirements Report
DB2	Agents Interface Specification Report
DD1	User Access Infrastructure Requirements Report
DD2	User Access Interface Specification Report

Outputs

DELIVERABLE	DESCRIPTION
DC1	Interface Specification Report
DC3	Working Version

WORK PACKAGE D: USER ACCESS

Summary

Work Package Leader:	FAST
Effort:	45 Person months
Start:	Month 5
End:	Month 13
Partners Involved:	APM. FAST, IZB

Objectives

A key objective of the project is to enable users to access the system through a variety of different media, but without losing quality of the interaction. In order to achieve this, a general mechanism for translating services onto devices needs to be constructed.

Tasks

TASK	NAME	DESCRIPTION
D1	Survey	Survey current device independent interaction technologies
D2	Requirements	Collect user access requirements
D3	Service Schema	Create general schema to specify services and device capabilities
D4	Design	Develop design for user access
D5	Interface Specification	Specify interfaces to user access components
D6	Implementation	Create working version
D7	Tests	Component tests

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
D1	Survey	1	1		1		
D2	Requirements	1	2		2		
D3	Service Schema	2	4				
D4	Design	1	2				
D5	Interface Specification		2				
D6	Implementation	6	10		6		
D7	Tests	1	2		1		
	Total:	12	23		10		

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design

Outputs

DELIVERABLE	DESCRIPTION
DD1	User Access Requirements Report
DD2	User Access Interface Specification Report
DD3	Working Version

WORK PACKAGE E: PILOT APPLICATION 1

Summary

Work Package Leader:	FAST
Effort:	50 Person months
Start:	Month 9
End:	Month 20
Partners Involved:	FAST, IZB

Objectives

In order to demonstrate and validate the architecture and the underlying components of the system, pilot applications will be developed.

Tasks

TASK	NAME	DESCRIPTION
E1	Requirements	Collect user requirements from Bavaria online and IZB
E2	Design	Design system
E3	Implementation	Create working version
E4	Deployment	Roll out system to users
E5	Trials	Perform system and user tests
E6	Evaluation	Evaluate system

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
E1	Requirements		2		1		
E2	Design		4		2		
E3	Implementation		18		7		
E4	Deployment		4		4		
E5	Trials		2		2		
E6	Evaluation		2		2		
	Total:		32		18		

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design

Outputs

DELIVERABLE	DESCRIPTION
DE1	Design & Objectives Report
DE2	Working System
DE3	Evaluation Report

WORK PACKAGE F: PILOT APPLICATION 2

Summary

Work Package Leader:	INRIA
Effort:	40 Person months
Start:	Month 9
End:	Month 20
Partners Involved:	INRIA, TC

Objectives

In order to demonstrate and validate the architecture and the underlying components of the system, pilot applications will be developed.

Tasks

TASK	NAME	DESCRIPTION
F1	Requirements	Collect user requirements from TC and Ouest Frances
F2	Design	Design
F3	Implementation	Create working version
F4	Deployment	Deploy system at users' site
F5	Trials	Perform systems and user tests
F6	Evaluation	Evaluate tests from trials

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
F1	Requirements			2		1	
F2	Design			4			
F3	Implementation			18		2	
F4	Deployment			4		2	
F5	Trials			2		1	
F6	Evaluation			2		2	
	Total:			32		8	

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design

Outputs

DELIVERABLE	DESCRIPTION
DF1	Design & Objectives Report
DF2	Working System
DF3	Evaluation Report

WORK PACKAGE G: EXPLOITATION AND SEEDWARE

Summary

Work Package Leader:	APM
Effort:	23 Person months
Start:	Month 1
End:	Month 21
Partners Involved:	ALL

Objectives

The aim of the exploitation package is to create general dissemination channels for the project to ensure that the architecture and software are widely used. The proposed approach is to freely make available "seedware" which will enable others to develop their own applications. The aim of the seedware is to act as a catalyst, encouraging academic and industrial organisations to adopt the techniques and software developed in the project.

Tasks

TASK	NAME	DESCRIPTION
G1	Dissemination	Information dissemination, via web home page, press releases, briefings.
G2	Exploitation Plan	Create plan for the exploitation of the project
G3	Seedware	Create a "seedware" software bundle from system components and pilot applications

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
G1	Dissemination	2	1	1	1	1	1
G2	Exploitation Plan	4	2	2	2	2	2
G3	Seedware	2	1	1	1	1	1
	Total:	8	3	3	3	3	3

Inputs

DELIVERABLE	DESCRIPTION
DA2	Architecture Report
DA3	Overall System Design

Outputs

DELIVERABLE	NAME	DESCRIPTION
DG1	Seedware	Produce freely available software which organisations can use as the basis or their own products
DG2	Exploitation Plan	Plan for the exploitation of the project results

WORK PACKAGE H: PROJECT MANAGEMENT

Summary

Work Package Leader:	APM
Effort:	12 Person months
Start:	Month 1
End:	Month 21
Partners Involved:	APM

Objectives

The project management work package runs for the entire life of the project. The project manager has a number of specific responsibilities such as the submission of management reports. In addition, the manager ensures that work is progressing as planned and possible problems are identified and dealt with.

Tasks

TASK	NAME	DESCRIPTION
H1	Project Management	Ensure schedules are maintained, organise meetings, produce reports, collate and submit cost claims.

Resources

TASK	NAME	APM	FAST	INRIA	IZB	TC	UWE
H1	Project Management	12					
	Total:	12					

Inputs

DELIVERABLE	DESCRIPTION
DA1	Architecture Report
DA2	Overall System Design

Outputs

DELIVERABLE	DESCRIPTION
DH1	Design & Objectives Report
DH2	Working System
DH3	Final project report

5.2 KEY MILESTONES AND DELIVERABLES

DELIVERABLE	NAME	MONTH
DA2	Architecture Report	4
DA3	Overall System Design	6
M1	Milestone 1	6
DB1	Agent Infrastructure Requirements	7
DB2	Agent Interface Specification	8
DD2	User Access Interface Specification	8
DC1	Infrastructure Interface Specification	10
DE1	Pilot Application #1, Design & Objectives	11
DF1	Pilot Application #2, Design & Objectives	11
M2	Milestone 2	11
DC3	Working Infrastructure	12
DB3	Working Agent Technology	13
DD3	Working User Access	13
DG1	Seedware	15
M2	Milestone 3	15
DE2	Pilot Application #1, Deployment	18
DF2	Pilot Application #2, Deployment	18
DE3	Pilot Application #1, Evaluation	20
DE4	Pilot Application #2, Evaluation	20
DG2	Exploitation Plan	21
DH3	Final Project Report	21

5.3 Gant chart

The following table displays the effort assignments for the different tasks in the workpackages: