ANSA

Research Programme for 1997

January 1997

ANSA 1997 Research Programme

Objective

The objective of the 1997 ANSA research programme is to deliver to the ANSA sponsors an in-depth understanding of the impact of mobile code and global networks on distributed systems technology in the 1998-2005 time frame.

In particular the research programme will explore the business opportunities and technical implications which arise from:

- changes in applications paradigms away from client-server computing to network-based decentralised multi-party models
- the replacement of static monolithic operating system and middleware based infrastructures by those based on downloaded, optimised dynamically configured modules
- the dissolution of network / service boundaries to enable communications-based applications to tailor and optimise networks to best meet user demands for flexibility, scaling, and performance.

Context

The ANSA research objective is set against major changes in the assumptions that underpin distributed systems architecture:

- the world wide web (WWW) has become an important technology for information publishing and will evolve to support electronic commerce transactions. The WWW has shown the benefits of simple extensible architectures based on principles of heterogeneity and federation
- the success of Java has spawned a new approach to rapid systems integration based on dynamic configuration of software modules across a network
- the simple yet expressive programming model inherent in Java has created significant opportunities for transparent tool-based approaches to link application modules with modules delivering the necessary supporting infrastructure. This replaces current monolithic operating system plus middleware approaches.
- the growth of the Internet is making computing and connectivity ubiquitous; in turn this is stimulating new concepts for applications such as active content and autonomous agents supporting mobile users, groups of cooperating users and business-to-business processes
- the increasing use of the Internet for business communications is bringing pressure to: support multi-party interactions, guarantee quality of service and effective end-to-end resource management. As the Internet evolves to meet these requirements there will be corresponding changes in the operating systems and distributed systems infrastructure.
- the growth of communications is putting the telecommunications network under increasing pressure to support broadband services, virtual networks with guaranteed quality of service and rapid provision of new services
- network computing is emerging as a paradigm for delivering applications to users which have the potential to reduce the cost of ownership for computing, but brings with it a requirement

for more server-oriented and dynamic system structures than is the case with desktop-based client server computing.

Results

The work programme will deliver results to the ANSA sponsors in the following format:

- Investigation Reports: studies and scenarios of emerging technologies and research results relevant to business and technology analysts
- Architecture Reports: descriptions of technology frameworks, components, interfaces, design principles and guidelines to benefit system designers
- Evolving robust prototypes to enable system developers to experiment with the architectural concepts and technologies
- Evaluation reports from trials of the architecture and prototypes indicating the likely impact and benefits to business

The Programme

The programme will consist of two principal projects; *Flexinet* and *FollowMe*.

Flexinet will focus on infrastructure for network applications with a paricular focus on interactive multi-media. It will build upon previous ANSA results in Reflective Java and the ANSA Distributed Interactive Multi-Media Architecture.

FollowMe will focus on the system support needed for network applications that support mobile users. It will build upon previous ANSA results in trading and applications of meta-data.

Flexinet

Following on from feedback to the basic Flexinet proposition discussed at the Flexinet workshop at APM on Friday December 13th 1996, the work will be divided into three topics:

- developing the Flexinet scenario
- extending Reflective Java as a modular dependability tool-kit
- quality of service for multi-party interactive multi-media applications.

Flexinet Scenario

To further develop the FlexiNet concept APM will develop an extended scenario based on the “surveillance system” example discussed at the workshop.

The scenario will:

- describe the system components and interfaces needed to allow for the dynamic introduction of the surveillance system into a network and the dynamic upgrading of the service in real-time
- develop the module, binding and reflective network concepts introduced at the workshop.

A simple animation of the system will be built in Java to test and demonstrate the key ideas.

The result of the work will be (see deliverable table and GANNT chart for dates and effort):

- a report describing the scenario in terms of concepts, architecture, risks and benefits
- the animation as a proof of concept demonstrator
- a plan for progressing to a full scale demonstration of Flexinet.

These will provide the basis for onward planning of FlexiNet investigations and developments.

Modular dependability

APM's work to date has shown the benefits of reflective techniques as a way to add dependability features to Java application objects in a transparent way. In the workshop the question was asked if the concept could be developed into a framework of composable meta classes for all the ANSA transparencies.

An investigation will be under taken to

- develop an architectural framework and configuration mechanism for a set of re-usable generic meta class modules for constructing the ANSA transparencies
  - concurrency control
  - atomicity
  - replication
  - checkpointing
  - persistence
  - security
- architectural investigation, examining various different approaches for plug in transparency (reflection, inheritance, dynamic modules and trading for classes)
- develop a binding language for expressing transparency requirements in applications
- develop a tools for selecting and configuring appropriate meta class modules to implement the transparency requirements expressible in the binding language
- develop examples of key meta class modules and evaluate the approach with respect to transparency, usability, flexibility, scaleability and performance.

The deliverables will be (see deliverable table and GANNT chart for dates and effort):

- An architecture framework report
- An implementation plan
- A definition of the binding language and framework
- A representative set of key meta classes
- An evaluation report.

Interactive Multimedia

This aspect of the Flexinet activity will push forward the investigation of distributed object models for interactive multi-media multi-party applications started in the DIMMA activity.

The top level goal for the work will be to architect and demonstrate a infrastructure to support "open signalling" and its applications. The OpenSIG group will be used as a vehicle to bring the results to the attention of the wider community with the objective of stimulating a broader industry initiative with the ANSA activity as its foundation.

The foundations of the work will progressively move away from CORBA towards Java and Java Remote Method Invocation. The pace of this transition will be driven by the results of the scenario task.

The focus of the work will be driven by the requirements for, and architectural issues of giving quality of service guarantees and support for multi-party interaction rather than on evolution of CORBA. Results from APM's involvement in the associated DCAN, RETINA and PEGASUS projects will be leveraged where possible.

The areas to be explored are:

- interfaces to connection oriented networks for quality of service control and multi-party interaction
- operating system support for meeting quality of service guarantees
- programming abstractions for writing software that meets temporal quality of service targets.

The following activities will be under taken:

- create binding model by extending the concepts and work in DIMMA, referencing RETINA for connection-oriented networks and DCAN for light weight ATM networks.
- showing
    - support for setting up multi-party bindings
    - support for dynamic addition or removal of parties from a binding
    - how to ensure type safety can be maintained
    - how to structure a library of composable binding templates
- extending the DIMMA resource model to enable user defined "plug-in" policy modules for allocating and scheduling resources (buffers, endpoints, objects, threads)
- show how to map the extended model onto current real-time operating systems
- investigate how to adapt the model for the new generation of "resource aware" microkernels (Pegasus, Exokernel, SPIN, L3, JavaOS).
- investigate the state of the art on network quality of service negotiation, set-up and management (Lancaster, CNET, Retina, XBIND, etc.)
- show how network quality of service relates to the extended DIMMA resource and binding models in achieving end-to-end quality of service guarantees.
- investigate the integration of technologies for writing modules with predictable timing (e.g., using reactive C or reactive Java) into the DIMMA framework for writing quality of service sensitive protocols and applications.

This work will be delivered as technical reports and a robust integrated prototype incrementally merged into the current DIMMA code base. The results will be (see deliverable table and GANNT chart for dates and effort):

- resource management abstractions
- microkernel investigation
- binding abstractions
- QoS review
- integration of QoS binding and resources
- predictable modules

Key Flexinet Deliverables at a Glance

The following tables shows the *key* deliverables in the FlexiNet agenda. In addition, to the normal range of reports and documentation, we will also be organising work-shops at regular intervals throughout the project.

Effort is represented in number of person months required.

Deliverable	Task	Effort	Due End
Report on scenarios and the benefits and issues they raise	FA1	1	March 97
Proof of concept demonstrator	FA2	5	May 97
Architecture for modular dependability report	FB1	2	May 97
QoS investigation report	FC4	1	May 97
Implementation plan for modular dependability	FB2	1	June 97
Micro kernel investigation report	FC1	1	July 97
QoS management abstractions	FC3	2	July 97
Definition of binding language and framework	FB3	3	August 97
Binding prototypes	FC2	5	September 97
QoS integration of bindings and resources prototype	FC5	5	October 97
Representative set of key meta classes prototypes	FB4	5	November 97
Predictable module prototype	FC7	6	December 97
Demonstration application	FA4	9	February 97
Evaluation report	FB5	1	March 1998

FollowMe

The second major project of ANSA 97 is FollowMe (originally called Puppies). At the ANSA Management Committee meeting in October 1996, it was agreed that ESPRIT funding should be sought to enlarge this project. A proposal to this effect was submitted to the Commission on 18 December. This proposal was organised with the ANSA objectives as a distinct part of work-plan. The Commission would normally announce their decision in early 1997.

Objectives

FollowMe will free the user from the confines of the fixed-location desk-top, delivering new mechanisms to use and access information and services in global networks. Users will no longer need to be tied to a particular location or device, instead they will be able to interact via a variety of devices and media, such as Psion-stype organisers, portables, pcs, gsm phones. FollowMe will develop an architecture for intelligent agent technology to create persistent user profiles and develop a process-driven approach to achieving user goals. The architecture will be validated through two industrial application pilots. The project will deliver Seedware which will be made freely available to encourage external development of additional applications outside the project.

The Need

The majority of IT users are restricted in their information use to a fixed desktop. The small percentage of users who attempt to be mobile find that this very mobility actually restricts their access to information. Mobility can affect many different types of user, for example:

- a technical director needs to be able to hold meetings, discuss and share information in a variety of places, and be contactable at all times
- sales representatives,sharing up-to-date information with customers, putting in orders and arranging schedules
- service engineers contactable for service enquiries and able access information using the available devices in their current location.
- a non-business user to access services, buy products, check email and send voice-mail from home, in the car or in a hotel.

For these users, it can be difficult to keep up-to-date information with them, and carrying around a laptop and mobile phone allows restricted access at best to the full breadth of information which they need. The key need is to remove the distinction between mobile and fixed-base users: the proposed paradigm creates one class of user, with the ability to access the full range of services and information available to them, wherever they may be. This market is expected to expand rapidly as more users make use of this new paradigm at leisure and work, and as the difference between different types of information - MS Word documents, email, GSM voice-mail, HTML pages, video, etc. - becomes blurred, and information becomes conceived as simply ‘information’. More users will work from home, and more users will need to share information with a variety of people.

The Market Drivers

- Business-to-business electronic commerce
- Mobile users
- Network computers
- New service providers.

In the world of electronic commerce there is a growing awareness that 'business-to-business' transactions will rapidly follow on from the currently emerging '(human) customer-to-business' systems and that the former systems will automate important business processes - for example negotiating re-order levels and prices for parts in Just-in-Time manufacturing. In the field of communications there is a pressing need for integration of the many forms of messaging by which people can keep in contact with one another. Moreover, it should be possible to use the same communications infrastructure that are used for messaging to command important applications that support users' electronic life. Network computers are an exciting innovation which provide an opportunity for new service providers (and their technology suppliers - e.g. Marimba) to download services for users in a business and to provide management of those services for the business. The network computer should not be solely an 'Internet terminal' but also the user's customised device for participating in collaborative tasks and acting as the user's 'virtual secretary'.

Partners

A requirement of the ESPRIT funding process is the creation of a consortium with representatives from at least two member countries. The following partners have agreed to participate in the project if it is accepted. They bring to the project capabilities which greatly enhance its scope.

Organisation	Country	Background	Role
APM	UK	Distributed system research	Project management, distributed systems architecture
IZB	D	Internet services provider	User access, Internet application pilot
INRIA	F	Intelligent agents & systems	News application pilot with Ouest-France
TC	F	Newspaper publishing products	User needs, news application pilot with Ouest-France
FAST	D	Advanced systems/consulting	Internet application pilot
UWE	UK	Intelligent agents	Mobile agents software.

The Results

The market drivers described above emphasise a transition in IT away from data-centric models, based in client-server relationships, to a process-centric approach. Moreover, these processes can be mobile, global in scope, shared by users, interactive and media-rich. The results include (see deliverable table and GANNT chart for dates and effort):

- an architecture, including design principles, interface specifications and implementation guidelines (leader APM)
- an infrastructure prototype, providing a complete basic version of a FollowMe working system, implementing the architecture (leader APM)
- Seedware - example software to encourage software generation by outside developers, made publicly available over the Internet to this end (leader APM)
- two proof of concept pilots - system to be built by FAST and IZB allowing users to interact with services provided by businesses via an ISP, the services personalising the information they provide based on the profiles, and one by INRIA and Ouest-France (TC), allowing users access to news on a variety of devices, personalised to their tastes.
- a report on the architecture, user needs, Seedware guide, the pilots and the experience in building them, for publication as a book, to be published within the Commission 's arrangements with Springer Verlag.

The Future - Products and Services

FollowMe technology will allow new products and services to enhance productivity in wide range of industry and service sectors including:

- health - sharing of information between users in many locations, access to information from a variety of sources by mobile users
- travel - availability of flights, hotels, etc. to users in many locations, then allowing ordering via agents with access to financial services.
- marketing & sales - mobile users' information which can then be shared with customers, allowing ordering from a variety of platforms and locations
- media and publishing - access by collaborating users to common bases of information, both read and write, movement between different information types, information sourcing controlled by agents
- banking and finance - access to information in a variety of formats, shared between many users in many locations
- support and engineering environments - providing information to users 'in the field', sensitive to their needs.

This will create opportunities for growth in:

- software developers
- service providers for infrastructure, especially ISPs
- consultants with experience in applying the technology.

Key FollowMe Deliverables at a Glance

The following table shows the main deliverables for the project. The initial involvement for the ANSA consortium is for the first year only.

Effort is represented in the number of person months required.

Deliverables in Year 1	Task	Effort	Due End
Overall architecture design	PA2	9	June 97
Infrastructure requirements	PC1	2	July 97
Overall System design	PA3	6	August 97
Infrastructure design	PC2	3	September 97
User access service schema	PD3	2	September 97
Infrastructure interface specification	PC3	2	October 97
User access design	PD4	1	October 97
Object location service	PC4	9	December 97
Working agent infrastructure	PC6	8	December 97
Working infrastructure for mobile objects	PC5,7	16	January 98
Working user access	PD6	6	February 98

Deliverables in Year 2	Task	Partners	Due End
Seedware	PG3	ALL	May 98
Pilot Application #1, Deployment	E	INRIA, TC	August 98
Pilot Application #2, Deployment	E	INRIA, TC	August 98
Pilot Application #1, Evaluation	F	FAST, IZB	October 98
Pilot Application #2, Evaluation	F	FAST IZB	October 98
Exploitation Plan	PG2	ALL	November 98
Final Project Report	PH1	ALL	November 98

Project GANNT Charts

FlexiNet

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
	Scenarios														
FA1	Benefits Report	1													1
FA2	Proof of concept demonstrator	1	2	2											5
FA3	Plan for full scale demo		0.5												0.5
FA4	Demo									1	2	3	3		9
	Modular dependability														
FB1	Architecture report		1	1											2
FB2	Implementation plan				1										1
FB3	Binding language & framework definition				1	1	1								3
FB4	Key meta classes prototype							1	2	2					5
FB5	Evaluation report													1	1
	Interactive Multi-Media														
FC1	Micro-kernel investigation report				0.5	0.5									1
FC2	Binding prototypes					1	2	2							5
FC3	QoS investigation report		0.5	0.5											1
FC4	QoS resource management abstractions				1	1									2
FC5	QoS binding and resources prototype						1	2	2						5
FC6	Java & DIMMA integration			0.5	1	1									2.5
FC7	Predictable module prototype								2	2	2				6
	Project Management														
	Management	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		6
															56
	Total Effort (Months):	2.5	4.5	4.5	5	5	4.5	5.5	6.5	5.5	4.5	3.5	3.5	1	56

Total Effort (Years): 4.7

PUPPIES

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
	Architecture														
PA1	Scenarios	2													2
PA2	Architecture		3	3	3						1	1			11
PA3	Design					3	3								6
	Object Infrastructure														
PC1	Requirements					2									2
PC2	Design						2	1							3
PC3	Interface specification								2						2
PC4	Location service								3	3	3				9
PC5	Basic infrastructure							2	2	2	2	2			10
PC6	Agent infrastructure							2	2	2	2				8
PC7	Mobility									2	2	2			6
PC8	Tests												2		2
	User Access														
PD1	Survey					1									1
PD2	Requirements						1								1
PD3	Service schema							2							2
PD4	Design								1						1
PD5	Interface specifications														0
PD6	Implementation								1	1	1	1	2		6
PD7	Tests														0
	Exploitation/Seedware														
PG1	Dissemination	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		3
PG2	Exploitation														0
PG3	Seedware														0
	Project Management														
PH1	Management	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		6
															81
	Total Effort (Months):	2.75	3.75	3.75	3.75	6.75	6.75	7.75	11.8	10.8	11.8	6.75	4.75	0	81