Poseidon House
Castle Park
Cambridge CB3 0RD
United Kingdom

TELEPHONE: **Cambridge (0223) 323010**
INTERNATIONAL: **+44 223 323010**
FAX: **+44 223 359779**
E-MAIL: **apm@ansa.co.uk**

ANSA Phase III

1994 - 1996 ANSA Work Plan

Abstract

This document sets out the ANSA Workplan for mid-1994 to mid 1996. It builds on work completed in the 1993-4 Work Plan, continuing the focus on dependability, performance, federation and automation for distributed object computing.

The 1994-6 plan sets the technical focus in the business context of wide area interactive multi-media information services which is seen as a key market for the 1990's and beyond, in which architectural insight can bring benefit in faster development of more robust and effective technology.

This plan is for approval by the ANSA Management Committee. The work will be performed by the ANSA Team and reviewed by the ANSA Technical Committee.

APM.1204.00.08 **Draft** 9 July 1994

Request for Comments (confidential to ANSA consortium for 2 years)

Distribution:
Supersedes:
Superseded by:

1 Vision

1.1 Electronic business

The combination of computerized information, interactive multi-media applications and broadband telecommunications is a springboard to the development of new technologies to help people live in an electronic world for going about their work, enjoying their leisure and protecting their health.

The technical challenge in achieving the electronic world is to combine technologies such as:

- information networking (e.g., the Internet and its electronic market place)
- the desktop (e.g., compound documents)
- broadband networks (e.g., ATM)
- multi-media
- databases
- embedded systems.

Federated, distributed object systems of the kind created by the ANSA architecture are the key to achieving this goal.

Electronic Business, illustrated in Figure1.1, is the driving scenario for the 1994-6 ANSA Work Plan.

The figure shows people using services, buying and selling products electronically. It assumes universal, simple and inexpensive network connectivity.

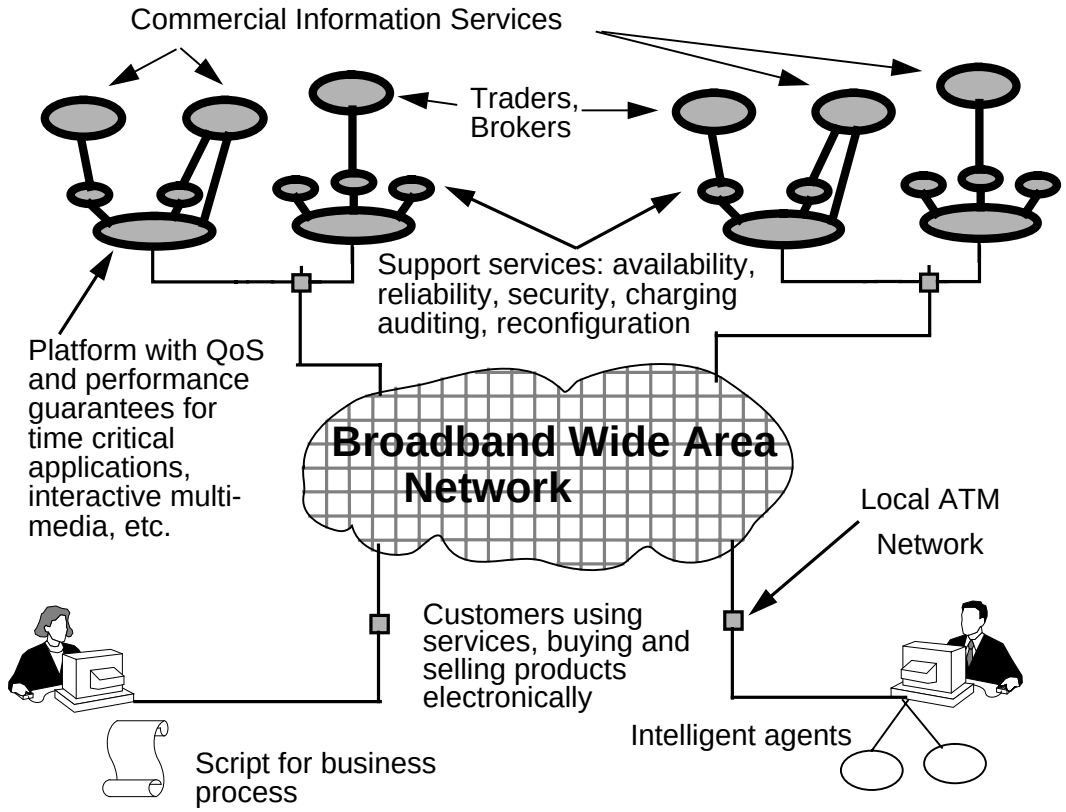
Today that connectivity is provided by the Internet: it is easy to connect to and cheap to use, but it offers few guarantees of performance, dependability and security.

To deliver interactive multi-media we have to look to the broadband wide area network where resource control is in place and guarantees can be given. Today the broadband wide area network is only just beginning to emerge and may never rival the connectivity or low cost of the Internet; however it will provide strong guarantees; therefore it is better suited to deliver trustworthy, effective commercial services.

In time, as the broadband network expands, Internet connectivity will be one of the many services it provides, as a widely available, low cost, simple mode of access to traders and brokers for more demanding services.

Organisations providing electronic information and services will be attached to the wide area network via local area broadband (e.g. ATM) networks containing servers running real time, dependable distributed object platforms.

Figure 1.1: Electronic Business



1.2 Management engines for information services

An information service takes data from many sources, automates critical business processes and arranges for information to be presented to users interactively in easy to use way. At its heart is mission critical, real-time, dependable data representing tasks in progress and a “Management Engine” coordinating those tasks and the resources of the underlying platform (see Figure 1.1.

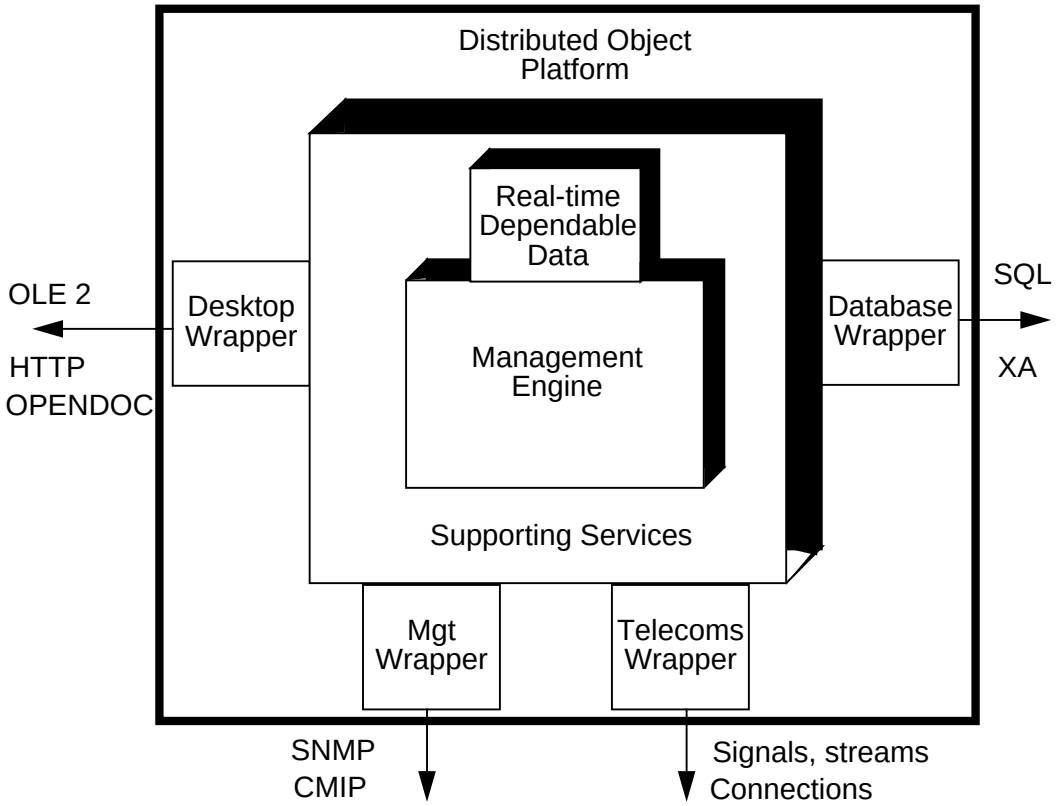
The platform interworks with telecommunications, desktops, and databases using object wrappers that act as gateways or interceptors from the distributed object world to the standards and technologies for these other functions. For example an HTTP wrapper can enable access to the information service from the World Wide Web.

Since it supports critical business processes, the platform gives well defined quality of service guarantees to time-critical functions and it enables dependable operation.

1.3 Brokers, agents and scripts

The electronic world is one in which users are swamped with data. Automatic observers and agents will act for users in their absence, monitoring events, receiving data and giving reports. For example, a mail agent that sorts incoming messages by priority and automatically handles those requesting appointments.

Figure 1.2: A Management Engine



Automatic brokers help users find the information and services they need, and orchestrate business processes involving more that one provider.

Brokers send transactional scripts across network for execution on the user's machine. For example, a customer may use electronic business to install a new operating system and a new set of applications on her computer. The software packages are provided by different vendors. A broker provides a script that ensures that the installation takes place correctly. The broker is paid commission by the vendors when the script is used.

2 Strategy

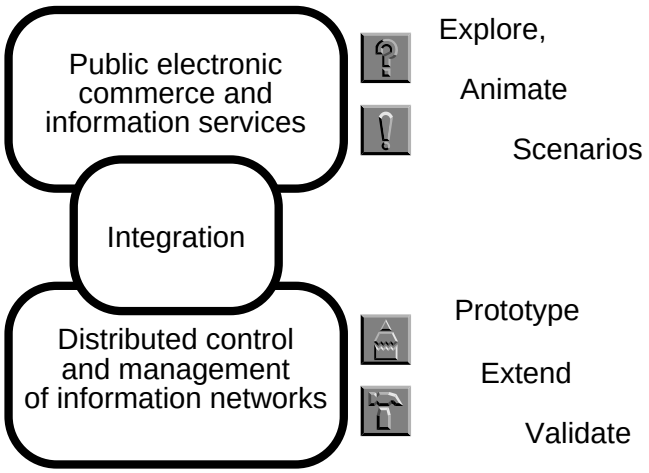
The plan divides the work for 1994-6 into two parts as illustrated in Figure.

One takes an application oriented view stressing scenarios, guidelines, animation and experimentation for public electronic commerce and information services.

The other takes a technological view of distributed control and management of information networks, addressing core architectural issue of performance, dependability and scaling.

In both parts the focus is on the key interfaces between information services and networks, since its is only by coupling these to that we can meet the demand for interactive multi-media information services. Moreover, developing these interfaces is a matter of distributed system architecture in which the ANSA team has acknowledged expertise.

Figure 2.1: Activities



A series of projects for each part of the plan is described in the next two chapters. The scheduling of the projects is described in chapter 9.

The work will be complementary to, and build on, the work of other groups focussed on the specifics of each part (e.g., World Wide Web Consortium for the electronic commerce, TINA-C for the information networks).

3 Public Electronic Commerce and Information Services

3.1 Direction

In this area, we propose to create an animation of support services which enable the competitive provision of dependable information services in wide area networks.

These support services will enable the prototyping of Management Engines. They provide support for all aspects of the commercial information service lifecycle, including: reliability, availability, reconfiguration, service installation, caching.

The Distributed Information Publishing System (DIPS) [APM.1171] developed in 1993-4 provides a scenario for a series of experiments to:

- validate architectural principles and real mechanisms for the construction of dependable applications
- investigate object replication versus object consistency techniques
- investigate interactions between high performance distributed object systems and remote information services
- investigate intelligent gateways between dissimilar environments (e.g. CORBA, the Internet, database management systems, transaction systems, and others)
- link the above into high performance distributed object platforms which can provide well defined quality of service guarantees.

In parallel with the animation of supporting services, we propose a second activity to explore the programming technology and supporting infrastructure required to support intelligent and automatic agents, including

- scripting technology
- naming schemes which move beyond the internet to scalable heterogeneous networks
- brokering technology to find the right service
- agents and observers for coordination of multi-party business activities
- investigation of the commercial, legal and copyright (IPR) issues of networking commercially valuable information.

This seen as a start of a large and open-ended activity that will evolve as the work continues. We have defined some initial activities and expect to add to them as our experience grows.

3.2 Projects

3.2.1 Object wrapped information services

This project provides two ingredients for later projects: the information resources needed to drive the scenario in which the management engine is to be tested and an initial tcl/tk based infrastructure for the Management Engine.

Application animations based on WWW HTTP access and use of distributed object technology will require the application and demonstration of federation principles. The location of appropriate resources will require the application and demonstration of trading and naming principles. Specific objectives are

- a CORBA wrapper for the HTTP protocol and associated “resources” (named by HTTP URLs) enabling CORBA-based implementation of WWW information services.
- use of trading and advanced naming concepts to extend capability of HTTP URLs to embedded CORBA based applications and mobile resources.

The project also provides a useful infrastructure to support the projects on Management Engines, and Scripts and Agents

Note: These deliverables build on 1993-4 plan deliverables D3: dependability engineering model and F4: interception.

3.2.2 Management Engines

This project is carried out in two phases. The first builds on the infrastructure provided by the previous project. It will allow experiments with failure models and dependability mechanisms. The second phase will build on the work done on distributed control (see §4). Having timed communications and rigorous quality of service guarantees makes the detection of failures a more tangible task: it is not possible to distinguish between a failed service and a slow running service in the absence of bounded time communication. The binding architecture and prototype will allow time-outs (bounds on communication) to be fixed at bind time.

The project will consist of a staged series of experiments to develop architecture and concepts in an application scenario:

- MED: Management engine for dependability, providing the basic services to make the commercial information services highly reliable and available and also supporting in-service upgrades.
- MEC: management engine for distributed implementation of information services, e.g. facilities for cache management. This could be prototyped using Orbix to build a CORBA based cache manager for CORBA HTML files. It could also be built on top of MED.

The current design proposal for MED [APM.1203] deals only with local area management of dependability. Both MED and MEC need to provide end to end services in a wide area network: what happens to customers if the local area network on which the service is sited becomes unavailable? How do they switch over to an alternative service. How is such wide area redundancy managed?

In the longer term the management engine could be extended to include facilities for the following.

- monitoring node load, thus enabling load balancing to achieve or maintain performance and QoS guarantees
- high-level resource coordination to deliver end-to-end resource control in a wide area broadband network: making sure the service is as close as possible to where it is needed (by caching), making sure the broadband and local area networks collaborate to deliver the right end to end channel capacity.

A strong link with the work on QoS architecture and engineering (§4) is clear. Many of the above were identified as being important issues in a recent workshop [APM.1220], [APM.1233].

Note: This project builds on 1993-4 plan deliverables D2: dependability management model and D3: dependability engineering model.

3.2.3 Scripts and agents

This area is investigative, growing out from the object wrapped information services to provide support for potentially mobile scripts and agents supporting multi-party information services and business processes. The investigation will cover:

- attribute and set based naming schemes
- agents and information brokering
- script technology to coordinate multi-party business activities in a wide-area network dependably.

Scripts are used to build composite services which require the existence of multiple parties. A customer retrieves a script from the network. When the script is run in the customer's machine, it invokes and orchestrates the remote services of various parties to deliver the composite service.

There are security issues which need to be solved to make sure that scripts retrieved from the network are trustworthy.

Note: This project builds on 1993-4 plan deliverables A8: Automated Transparencies for Dependability, D2: dependability programming model, and D3: dependability engineering model.

3.3 Issues

There is an imminent window of opportunity within which we will be able to influence emerging technologies such as the electronic marketplace and encourage them to take up Open Distributed Processing principles. The ANSA team relies on the support of its sponsors in seeing this opportunity is not missed, otherwise the distributed object world end up as a legacy system, rather than an integrating technology.

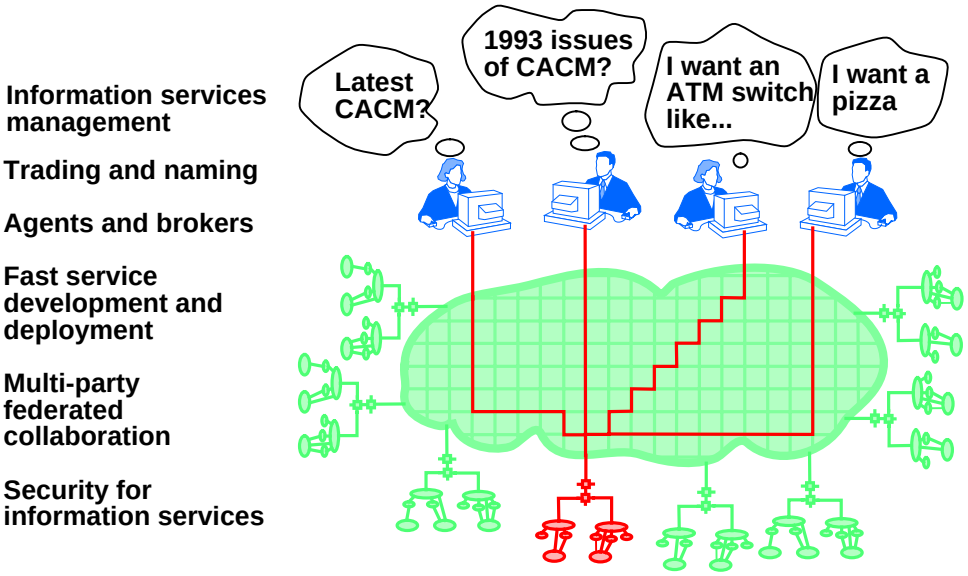
The projects assume access to a CORBA implementation, as this facilitates technology transfer and at some point we may wish to insert dependability mechanisms “into” the CORBA implementation. This issue is even more important for the work on distributed control of information networks and is discussed in §4.3

Initial prototyping will be done using tcl/tk since it a publicly available system.

3.4 Results

The success of the work on public electronic commerce and information services will be judged on the use of the results by sponsors in developing information services. Example areas in which the results should contribute to technology are illustrated in Figure 3.1.

Figure 3.1: Use of results



4 Distributed control of information services networking

4.1 Direction

It is proposed to focus on architecture for distributed services management, service binding and service quality and resource management at a level of abstraction consistent with the applications programming interfaces found in current distributed object computing systems such as ANSAware, Microsoft's OLE 2, the Object Management Group's CORBA standard and Bellcore's INA.

The programme of work will address

- the extensions that are needed to current distributed computing object models, and their manifestation in applications programming systems
- the additions and extensions that are needed to supporting services for distributed services management (e.g. the ANSAware / INA trader, the OMG repositories), including additional functions
- the extensions needed to current distributed object computing infrastructures to enable interworking between them (e.g. support for multi-protocol ORBs, interception mechanisms)
- the extensions needed to current distributed object computing infrastructures to enable fine grained control and monitoring of resources to give integrity to quality of service guarantees
- the linkages between supporting services for distributed services management and fine grained control and monitoring of resources into an overall distributed system.

The work will use the ODP object model, and the work to date in ANSA on trading, configuration management, explicit binding, quality of service management and performance management as a baseline.

The planned work will

- detail and animate the architecture outlined above
- develop prototype technology that shows, using experimental and demonstration applications, what has to be added to current distributed object computing systems to meet the challenges above
- identify strategies for enhancing the manageability, performance and predictability of current distributed object systems (and their supporting operating systems).

4.2 Projects

Main thrust: an incremental stream of architecture and prototype technology primarily directed at sponsor broadband interactive multi-media projects, backed up by consultancy on applications of the technology and its transfer into other contexts.

4.2.1 Federation and life cycle

Whilst first generation OMG object services for life cycle and naming have been defined, extensible schemes for trading and managing distributed objects in federated systems have not been forthcoming because of hard technical problems that rule out current simple minded solutions and a lack of coherent architecture.

We propose to work on:

- ORB interoperability - including consultancy on OMG input, and impact on CORBA repository architecture
- Integration of trading and repository services with life cycle services to provide federated object management.

4.2.2 Architecture for distributed interactive multimedia

Distributed interactive multi-media requires architecture for

- explicit binding of interfaces, including streams, including end-to-end definition of QoS
- interfaces for interaction with a wide range of multi-media sources (signal interfaces)
- synchronization of activities driven by streams and signals
- orchestration of composite media across individual streams
- dependability and performance aspects
  - — resource separation
  - — independent scheduling
  - — timeliness in failure detection
  - — bounded recovery mechanisms
  - — high performance redundancy management
- high performance recording mechanisms.

We propose to build on the concepts defined in ODP and TINAC, using results already accomplished to develop a full architecture, scoping both the application programmers' interface and the structure of the supporting engineering.

Issues of multi-media presentation and storage our outside our scope.

4.2.3 Engineering for distributed interactive multimedia

This project is concerned with validating the engineering aspects of the distributed interactive multi-media architecture in §4.2.2. A prototype will be built showing

- an extensible distributed object run-time environment Optimised for use in real-time systems (derived from ANSAware)

- signal handling and signal synchronization
- end-to-end quality of service negotiation and set up
- performance and dependability features.

4.2.4 Application programmer's interface for distributed interactive multi-media

This project is concerned with presenting the applications programmer with a clean high level interface to the engineering developed in §4.2.3, using the ANSA principles of "Abstract and Automate". It is part of the validation of the architecture developed in §4.2.2.

The project is broken into to steps

4.2.4.1 Extensible repository

Develop technology to support an extensible interface repository (i.e. conformance based type checking) and an extensible implementation repository (i.e. abstract syntax tree support).

This project is complementary to §4.2.1 and will proceed alongside it.

4.2.4.2 Distributed Interactive Multimedia API

Develop extensions to C++ preprocessors and libraries to support streams, signals, explicit binding, QoS management, synchronization and orchestration.

This project depends on §4.2.3.

4.3 Issues

The emerging industry standard for distributed systems platforms is OMG's CORBA. Therefore in doing the work, any service which can be implemented on a CORBA platform and accessed remotely, should be. These services would include:

- integrated trader, repository and life cycle services for federated systems
- interceptors for interworking.

APM.1059 showed that real-time functionality could not be added on top of a CORBA platform, but had to be built-in to it. Therefore we have the following options:

- obtain a source licence to a CORBA product
- help a CORBA vendor extend their product
- build our own extended CORBA technology.

The first is unattractive as it would lock the results into a single vendor's product, and moreover the version of the product used could be made obsolete by the vendor's own developments.

Rolling our own real-time CORBA platform (based on ANSAware), or helping a vendor evolve a CORBA product will involve:

- provision for multiple protocol stacks with selective multiplexing from the link layer to the application layer
- time bounded protocols
- explicit binding and QoS engineering

- resource separation and independent scheduling
- dependability mechanisms
- ability to map onto any suitable real-time technology

The ORB interoperability work should provide a basis for interworking between a real-time CORBA and other CORBA products.

Neither ANSAware nor current CORBA products provide programming support for streams, sychronous programming, explicit binding or extensible types, all of which are key components of the ANSA performance framework (see APM.1137). Therefore technology must be developed including:

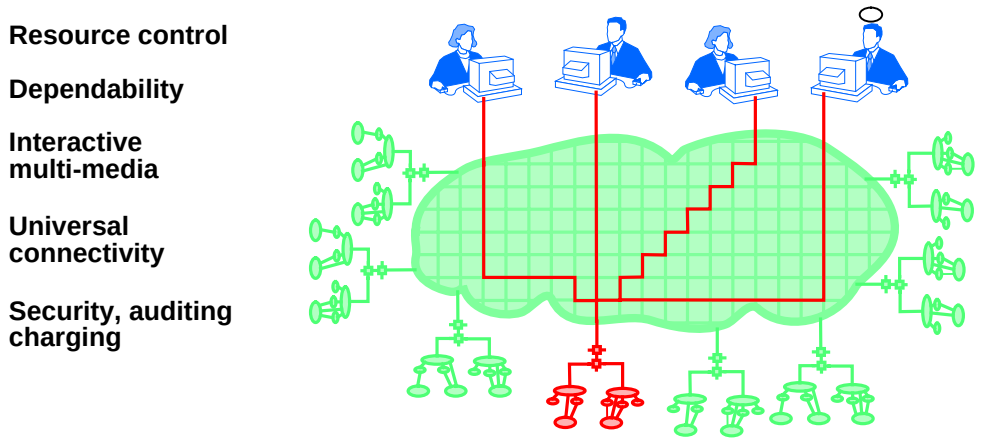
- libraries, macros or extensions for C++ which adds stream, signal, binding and synchronous programming related concepts
- a type inferencer and type conformance checker for operation, stream and signal interfaces, so that interfaces are extensible and support subtyping
- C++ libraries wrapping the engineering support
- an implementation and interface repository which supports objects using signal and stream interfaces as well as operational interfaces.

We will use Abstract Syntax Tree techniques in the implementation of the repositories to keep components as independent as possible and to allow cross ORB and cross language working.

4.4 Results

The success of the work on distributed control of information services networking will be judged on the use of the results by sponsors in developing testbeds and infrastructure products for information services. Example areas in which the results should contribute to infrastructure products are shown in Figure 4.1.

Figure 4.1: Use of results



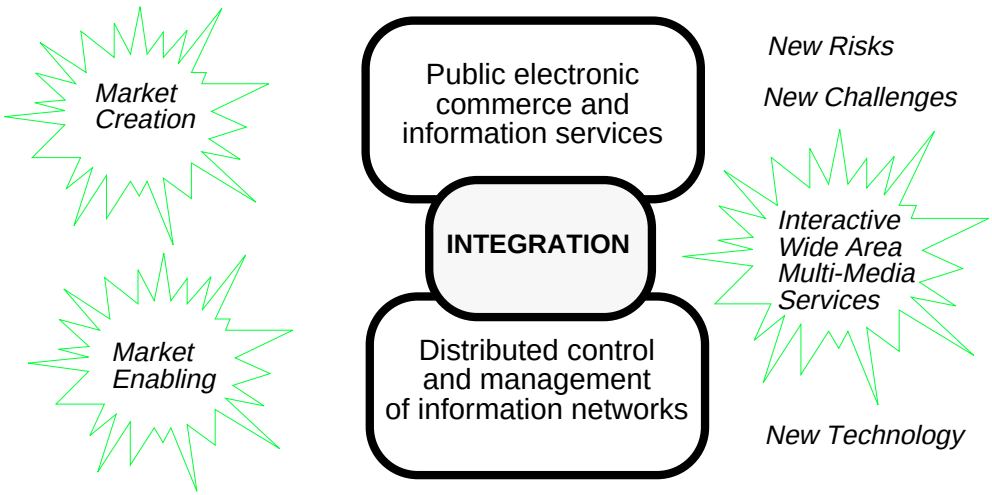
5 Benefits

The experimental work will help the ANSA sponsors create the market for information services and to understand the new challenges and risks of that market.

The prototyping and validation work will help the ANSA sponsors develop new technology to enable the market.

By focusing on architecture and interfaces between the two, the planned work accelerate the ANSA sponsors towards successful interactive wide-area multi-media services, as shown in Figure 5.1.

Figure 5.1: The market



Significant benefits that flow from the planned work are shown in Table 5.1

Table 5.1: Example benefits

Results	Enable	Benefit
Scenarios / animations for distributed commerce	New services; consensus and products	Revenue from new services; user confidence in services; avoid legislative backlash
Agents, scripting prototypes	Tools for service developers	Faster to market; better services
Management engine prototypes	dependable applications on open platforms	larger market for open systems
Federation prototypes	Controlled interworking; applications integration	Faster response to market change
Quality of service, performance prototypes	Interactive multi-media; distribution of, and into, embedded systems	Deliver time critical (interactive) services; access entertainment market

6 Where next

The plan does not commit all the effort for 1994-6. The remaining effort will be used to spawn further areas of research that arise as the planned work develops, and the requirements of electronic business in particular, and the electronic world of distributed interactive multi-media become clearer.

This additional work ill be recommended to the sponsors by the Chief Architect.

The following is a first guess at possible topics:

- use the distributed control of information networks prototype to support a wide-area Telecoms service (e.g. for VPNs over ATM)
- develop a tiny operating system kernel for an optimized performance version of the distributed control of information networks prototype
- develop a management and signalling architecture for local ATM networks where control and management is separated from switching and devices
- investigate business process driven modelling of distributed systems
- prototype declarative approaches to distributed programming (including scripting, event-condition-action, deductive etc.,)
- extend distributed object repository technology to capture semantic understanding of applications
- explore how to manage precision and consistency of information in federated systems
- provide automatic content-based indexing and analysis of information resources
- architect charging and licensing of information services in federated systems
- develop techniques detached information handling supporting subsequent arbitration and reconciliation upon reconnection.

7 Technology transfer

7.1 Process

The work will be executed as a series of projects, one building on the results of another. The ANSA architecture will be the glue that binds the projects together.

Each project will develop and test ideas as well as animate the ideas or build a prototype of necessary technology.

Each project will produce:

- regular work in progress reports on accomplishments and lessons learned, explaining how results can be applied in other situations
- briefings, scenarios and animations to explain the approach and benefits of the project (“marketecture”)
- technology transfer, via workshops, input to sponsor’s projects and consultancy
- technical reports on the design of animations and prototypes, along with accompanying software
- architectural reports on lesson learned, and implications for other applications of the architecture.

7.2 Effort

Technical effort will be divided across these activities thus:

- core technical development: 70%
- marketecture: 5%
- standards: 5%
- consultancy: 15%
- ANSA team support activities: 5%

7.3 Standards

The standards activity for 1994 will be directed towards:

- completion of the architectural aspects of the ISO/ITU-T Reference Model for Open Distributed Processing
- the OMG CORBA 2.0 standard and related Object Services standards.

Recommendations for 1995and 996 standards activity will be made by the Chief Architect as the work progresses.

7.4 Technology from scenarios and animations for electronic business

The animation and scenarios work will demonstrate several key architectural issues and prove the feasibility of the proposed mechanisms.

The results will be transferable to

- developers of dependable applications which need to run in a networked environment
- developers of telecommunication system management applications
- system integrators with an interest in dependable computations.

The link between CORBA and the World Wide Web that will be developed to support the animations will be of more general use for giving Internet access to information services built using CORBA technology.

7.5 Technology from distributed control of information networks

In the first instance prototypes will be targeted at sponsors' broadband interactive multi-media laboratory work and field trials. However the architectural results underpinning the technology will be transferable to

- developers of interactive multi-user, multi-media desktop applications for the home or office
- developers of telecommunications service management and network management products
- developers of open real-time embedded control systems in command and control, process control and manufacturing automation.

The prototyping work will be of particular relevance to:

- development of interworking technology (both between OMG Object Request Brokers and other standards, such as OLE 2)
- distributed connection and quality of service management in broadband telecommunications services (e.g. virtual private networks), including cooperation with TINAC
- distributed supervisory control in process automation and command and control systems
- performance enhancements for distributed object computing environments such as DCE and CORBA
- alignment of OMG repositories and ODP trading and type repository functions
- interworking between distributed object computing environments (including support of development of OMG ORB interoperability submissions).

8 Managing the work

AJH note: This belongs in a MC/TC policy note not the plan?

8.1 Management Committee

The Management Committee appoints a steering group of 4-5 senior figures to set the vision and direction for ANSA, jointly the Chief Architect.

The Chief Architect develops a rolling two year plan and submits it for annual approval by the Management Committee.

The Management Committee agrees the resources required to execute the plan, with the advice of the Programme Director.

The Management Committee sets policy for the transfer of results outside the ANSA Consortium, into standards, projects and other organizations, with the advice of the Programme Director and Chief Architect.

8.2 *Technical Committee

The Technical Committee reviews work in progress for quality and benefit to sponsors, reporting to the Management Committee.

The Technical Committee agrees requirements and goals for each project within the plan with the Chief Architect.

The Technical Committee advises the Programme Director of opportunities and requirements for technology transfer.

The Technical Committee advises the Chief Architect on means to ensure successful transfer of results to standards.

8.3 Programme Managers

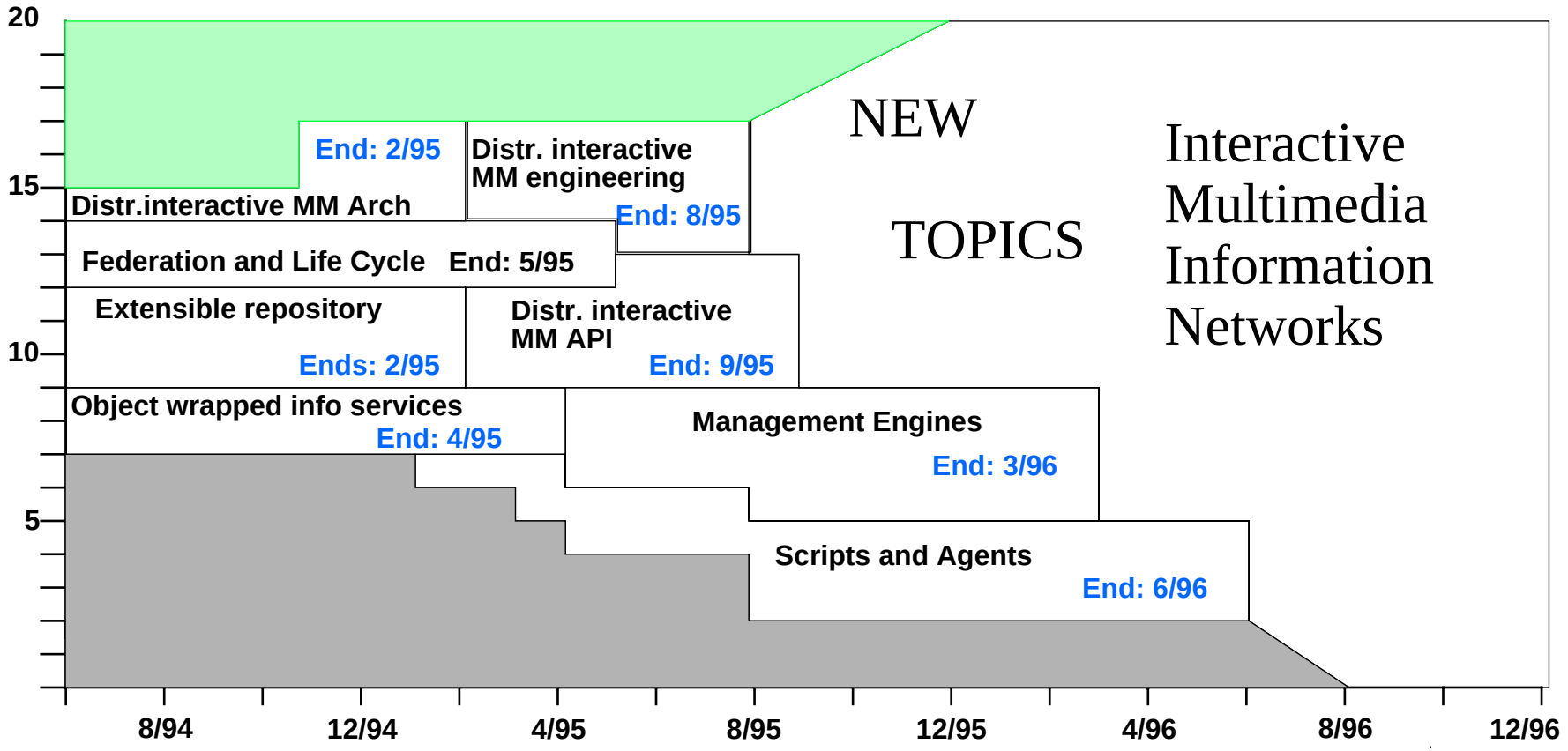
The Programme Director and Chief Architect are jointly responsible for the execution of the plan, and for reporting progress and issues to the Management and Technical Committees appropriately.

The Programme Director is responsible for progress and technology transfer.

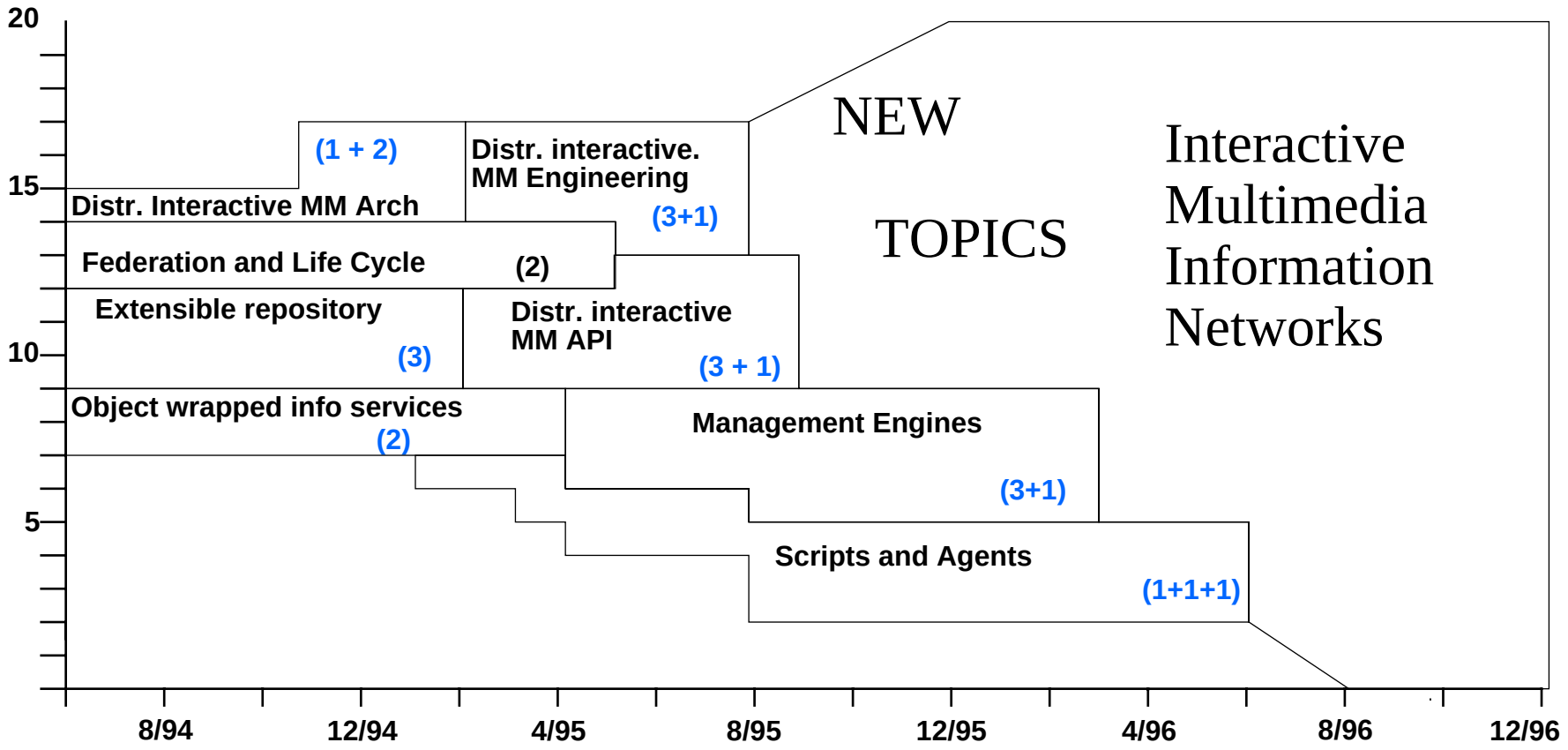
The Chief Architect is responsible for technical leadership and architectural integrity.

9 Charts

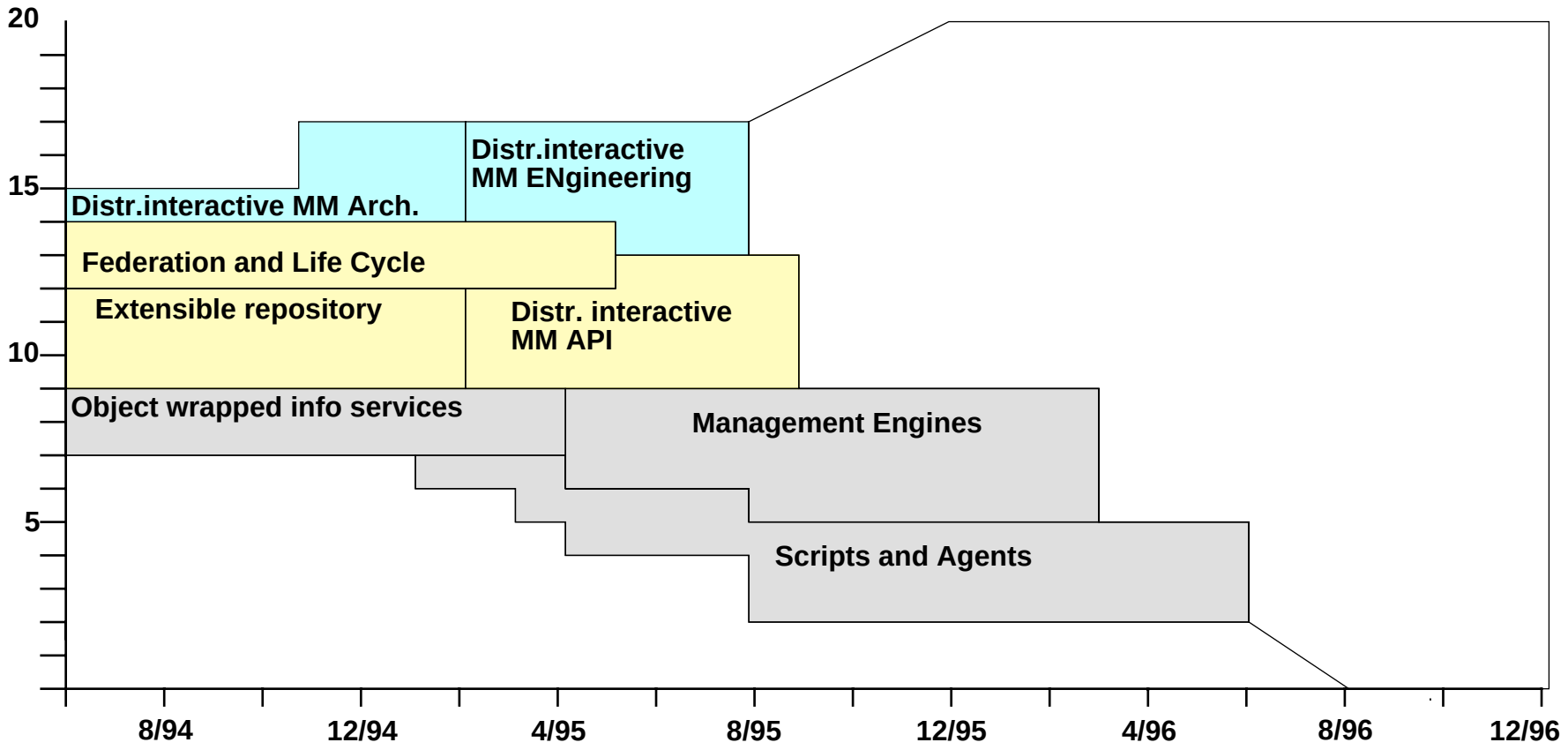
Dates


20
15
10
5
End: 2/95
Distr. interactive
MM engineering
End: 8/95
Distr.interactive MM Arch
Federation and Life Cycle
End: 5/95
Extensible repository
Ends: 2/95
Distr. interactive
MM API
End: 9/95
Object wrapped info services
End: 4/95
Management Engines
End: 3/96
Scripts and Agents
End: 6/96
NEW
TOPICS
Interactive
Multimedia
Information
Networks
8/94
12/94
4/95
8/95
12/95
4/96
8/96
12/96

Staff


20
15
10
5
8/94
12/94
4/95
8/95
12/95
4/96
8/96
12/96
(1 + 2)
Distr. Interactive MM Arch
Distr. interactive.
MM Engineering
(3+1)
Federation and Life Cycle
(2)
Extensible repository
(3)
Distr. interactive
MM API
(3 + 1)
Object wrapped info services
(2)
Management Engines
(3+1)
Scripts and Agents
(1+1+1)
NEW
TOPICS
Interactive
Multimedia
Information
Networks

Reporting groups



References

[APM.1171]

Ed Oskiewicz, Nigel Edwards, “IPS - An Information Publishing System”, Request for Comments document 1171, April 1994.

[APM.1203]

Nigel Edwards, Ed Oskiewicz, “MED: A CORBA-based Management Engine for Dependability“, Request for Comments document 1203, May 1994.

[APM.1220]

Nigel Edwards, “Commercial Information Services in the World Wide Web“, Briefing Note 1220.01, May 1994.

[APM.1233]

Nigel Edwards, Ed Oskiewicz, Owen Rees, “ANSA & Commercial Information Services“, Request for Comments document 1233, May 1994.