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ANSA Phase III

ORBIX for Interactive Multi-Media

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Abstract

A proposal for extending ORBIX with facilities to support distributed interactive multi-media applications.

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

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1 Introduction

There is a clear need for an extended version of CORBA to meet the needs of developers of distributed interactive multi-media applications developers. The emergence of low cost broadband networks is opening a market for such applications, but development is inhibited by the lack of a high level applications platform which can meet both functionality and performance requirements.

The telecommunications industry in particular is looking to an open systems solution to this problem. Deregulation, the pressure to reduce costs and the need to compete by offering new services are driving the industry to a model where services are implemented outside of network switches, using readily available hardware and software.

Through activities such as the Telecommunications Information Networking Architecture Consortium (TINA-C), both computer and telecommunications vendors are settling on the ISO/ITU-T Reference Model for Open Distributed Processing as a framework, and products based on OMG standards as technology for the “distributed processing environment (DPE)” to support interactive, multi-media services.

Current CORBA products are not immediately suitable for use as a DPE for the following reasons

1. they do not support appropriate connection (i.e. binding) and interaction models for multi-media traffic such as voice and video streams
2. they do not enable fine grained control over resources and scheduling to meet quality of service and real-time guarantees
3. they do not allow for encapsulation of alternative protocols (e.g. signalling protocols, management protocols, real-time protocols) within an ORB
4. the support for object life cycle and dynamic extension / re-configuration of DPEs is limited
5. object services for dependability (transactions, replication, security) are lacking.

Current ANSA work is providing software that meets requirements 1-3, and which contributes to requirement 4. Ideally this software should be delivered to C++ / CORBA interfaces so that it is widely applicable and standards conformant.

Requirement 5 is outside the scope of this proposal except to note that meeting requirement 1-3 will provide the hooks to make such object services transparent to applications and for different transparency selections to coexist.

2 Requirements

This sections reviews the requirements of distributed interactive multi-media, as captured in the ANSA work to date, and the implications for adding the appropriate capabilities to a CORBA-based environment.

2.1 Multi-media objects

Interactive multi-media services involve handling voice and video as well as programs. Voice and video communications is better captured as a stream consisting of a sequence of “frames” with well-defined timing characteristics. Streams can be bi-directional. Whilst control interfaces to multi-media devices and services fit the CORBA model conveniently, the communication interfaces do not. Some applications however may want to drive streams directly, e.g. to edit and capture “live” media, to perform real-time media conversion and so forth. Thus whilst multi-media objects require a different invocation interface orthogonal to CORBA it is desirable that CORBA and associated object services can be used to name, distribute and manage objects with stream interfaces. This has implications for the CORBA type system and the structure of object pointers.

2.2 Binding / connection management

Multi-media applications involve setting up potentially complex configurations of objects (e.g., to support a workstation conference). This requires an explicit binding model in which one object (the conference manager, say) can link other objects into a binding and control the binding as a whole. The explicit binding model, like the implicit binding model in CORBA should be type safe. The binding process may be a quite complex distributed algorithm and therefore it is desirable that it should be built as an application so it has all the benefits of transparency, security etc. which an ORB an provide. This in turn requires an extension of CORBA by which binding applications can cooperate with the binding machinery with the ORB itself.

2.3 Scheduling

To meet the stringent timing characteristics of voice and video, multi-media applications need to manage resources, such as processors, threads and buffers carefully. For example a pool of resources may need to be hard-wired to a critical object. This has two implications - firstly that the underlying operating system enables fine grained control of resources and secondly that a way is found to tie those low level controls to the working of an ORB. This requires extension of CORBA to accommodate resource pooling and application input to scheduling decisions

2.4 Multiple protocols

The use of streams and real-time communications inevitably leads to an ORB handling alternative protocol stacks with extensions that enable applications to exercise control over the selection of protocols on binding and to feed through quality of service requirements (e.g. timeouts) for individual interactions.

2.5 Interoperability and extensibility

The requirements of explicit binding and multiple protocols echo a number of requirements for extensions that enable ORB interoperability and to allow layering of ORBs over other transports (e.g. replication protocols and transactional message passing)

3 Technology

The ANSA work programme has already generated technology to meet the requirements outlined in Section 2, and the remaining pieces are scheduled for development in 1995:

1. a combined threads / request dispatching system for allocating and controlling cpu resources (part of real-time ANSAware)
   - task, thread and entry manager
   - scheduling control points
2. a real-time RPC protocol with delivery / timeout parameters (part of real-time ANSAware)
3. a type checker for conformance-based type matching of abstract data types as a basis for an enhanced interface repository supporting federation and trading (in prototype)
   - abstract syntax tree
   - type conformance checker
   - enhanced trader
4. an API based on the synchronous programming and the ODP concept of signals for writing predictable, event-driven “reactive objects” (design in progress)
   - event manager
   - reactive kernel
   - buffer manager
5. an API and framework for distributed explicit binding (connection management in telecommunications speak) including dynamic selection of protocols and interceptors based on quality of service declarations (design in progress)
   - type safe binding manager
   - interface (object) reference manager
   - channel manager
   - session manager
   - endpoint (connection) manager
   - communications protocol stacks manager.

The engineering mechanisms will be delivered as a modular kit of parts for an “new” ANSA nucleus mostly written in C++. The current API design is in terms of DPL, an internal prototyping language used by the ANSA team and the historical ANSAware PREPC and IDL.

It would be more useful in terms of alignment to standards and interworking with other systems to implement the API in terms of C++ classes and CORBA interfaces.

However to do so requires the means to “open up” an ORB so that

- multiple, alternative protocols can be supported, and applications programmers can select protocols on a per interaction basis
  - — means to dynamically add protocols to the ORB
  - — support for alternative endpoints in object references
  - — use of “contexts” to guide protocol selection
- multiple, alternative transfer syntaxes can be supported and applications programmers can defined bespoke encoding / decoding (e.g. moving video data to a framestore before signalling the application)
  - — ability to override default transfer syntax
- quality of service parameters can be specified for individual interactions
  - — use of “contexts” to carry extra parameters
- applications programmers can provide alternative binding mechanisms for individual objects
  - — ability to dynamically add alternative binders and to explicitly manage network level bindings
- applications programmers can control requesting and dispatching policy with respect to both real-time and cpu resources.
  - — ability for application to take full control of cpu resources

We believe that the changes required to open up an ORB for our purposes are similar to those required to enable transparent use of replication protocols and transaction protocols, and to enable ORB interoperability.

We are looking to ORBIX as the target ORB for prototyping because

- IONA are an ANSA consortium member
- IONA already have work under way on opening up ORBIX
- ORBIX is unencumbered by a legacy of protocol / management infrastructure.

Other ORB vendors in the ANSA consortium may wish to track or duplicate the work. This is seen as a significant opportunity to stimulate agreement on extensions to CORBA, and a candidate for OMG standardization.

4 Benefits

For ORB vendors there is a significant benefit in agreeing the internal interfaces needed to meet the functions described in Section 2: vendors of technology for transaction systems, replication systems, security systems, management protocols (e.g. CMIP, SNMP) and multi-media technology (e.g. integrated decompression/display hardware) can design their technology to plug into any ORB.

The ANSA Consortium provides an ideal vendor neutral forum in which to prototype and agree the internal ORB interfaces. From ANSAware, we have considerable experience in structuring the internals of an ORB. Indeed the ORBIX designers benefited from interaction on this topic with the ANSA team in the ESPRIT HARNESS project.

It is more sensible for the ANSA team to work with an available CORBA implementation rather than invent our own - we would be unlikely to do better than duplicate the ORBIX design. The goal of defining consensus on internal ORB interfaces protects the other ANSA sponsors from the results being locked into ORBIX.

The latent market for the resultant technology is evident from

- the inability of TINA-C to accept any current technology as a baseline DPE
- several distributed multi-media projects (including some involving ANSA sponsors, and APM's Business Unit) taking ORBIX source licenses with a view to making real-time / quality of service extensions
- customer pressure on APM's Business Unit to put a CORBA layer on ANSAware, so that people can protect their investment in engineering enhancements to ANSAware, yet meet an important industry standard.[1]

1. APM feels partnering with one or more ORB vendors to deliver our engineering through a CORBA framework is the best way to satisfy this need - we have no desire to build our own CORBA technology sine this is outside our research mission.

5 Process

- Agreement in principle to work together on defining the minimum necessary ORB internal interface(s) to permit extensibility and interworking.
- ANSA team / ORBIX designers dialogue on strategy for opening up ORBIX. [11/94-3/95]
- ANSA team to continue and complete engineering design and prototypes.
- ANSA team / ORBIX joint workshop to finalize internal interface specification. [4/95]
- Internal interface design offered to ANSA sponsors for review
- APM / IONA agree basis for developing internal interface implementation [during 5/95,/95]
  - — ANSA team builds prototype using IONA source, or
  - — IONA implements directly (preferred)
- ANSA Team delivers ANSA engineering prototypes wrapped in ORBIX.

6 IPR

6.1 Scope

This section outlines the proposed arrangements for the control and ownership of IPR relating to the proposed work to be done in real-time aspects of CORBA systems, which it is anticipated will use ORBIX as its basis, within Phase III of the ANSA Work programme and under the sponsorship arrangements introduced by Contract Amendment 2 to the ANSA Phase III Sponsorship Agreement (which, in particular, allows for confidential work to be done within the sponsor's consulting days).

6.2 Backcloth

Increasingly in Phase III of ANSA there is a need for the team to work with individual sponsors or groups of sponsors on particular product orientated topics, wherein the work w ill be confidential to that group of sponsors. The Management Committee has recognised this, the principle being that Architectural Principles and potential standards which result shall be shared but that specific results and code are confidential to the group of sponsors, who must contribute software and some of their own effort in addition to using their "consulting days" for the team's time on the topic.

The additional protection of background software by requiring APM to enter into a non-disclosure agreement has already been successfully undertaken (for Hewlett Packard in respect of certain advanced releases software made available by that company to assist the ANSA Work programme). In this case certain results were and remain confidential to APM and Hewlett Packard.

6.3 Definitions

The definitions of terms are those of the Sponsorship Agreement and the Project Management Agreement.

6.4 Background

ORBIX is contributed as Background commercial software. It is made available solely for the purposes of the specific task and only to those members of the ANSA team at Cambridge who are working on said task. In particular APM agrees to keep Iona's source code confidential and will if required by Iona sign a non-disclosure agreement. For the avoidance of doubt, other sponsors may only access ORBIX, whether in binary or source form, if they have an appropriate licence.

6.5 Results

The results of the work will be of two types. First there will be a set of new interfaces which it is hoped will form an extension to the OMG's specification for CORBA. It is the intent that these shall be open standards and, in line with the aims of ANSA, these will be made openly available to all sponsors and may, if the Management Committee so decide, be proposed as industry standards. The content and definition of these interfaces may be discussed by all the sponsors as the work proceeds but such discussions shall specifically not include the details of their implementation in ORBIX. These results will be Phase III Results.

The benefit of using a commercial product such as ORBIX for the base is that these open results will be development more quickly than would be the case if the work had to start from "open" software which has shared ownership (such as ANSAware) and no inhibitions on IPR. It is considered inappropriate and not cost-effective for the ANSA team to develop software which is already commercially available.

The second type of result is the actual internal code and code modifications made to ORBIX to realise these interfaces and prove that they work. This work is expected to be carried out jointly by Iona and members of the ANSA Phase 3 team. These shall be classified as Confidential Results and will not be classed as Phase III Results and will therefore be confidential to Iona and APM. They will not be shared or owned by the other sponsors; the benefit to other sponsors is the interfaces and potential standards and the opportunity to interact in their definition.

From time to time Iona and APM may jointly agree in writing that certain parts of the code, [which, for the avoidance of doubt it is anticipated would be "inside" the new interfaces (i.e. towards the kernel)] shall be made openly available to other sponsors where either (a) this will facilitate uptake of the standard or (b) Iona does not wish to commercialise or exploit said code.

The ANSA Technical Committee may from time to time suggest that an open discussion, or discussion between all sponsors, of certain aspects of the implementation may be beneficial to all parties. Iona will consider such requests sympathetically and reasonably but shall not be bound to agree to any such request.

6.6 Exploitation

All sponsors shall have the right to exploit the new interfaces, which are classed as Phase III Results.

Iona shall have the rights to exploit the Confidential Results, the other sponsors shall not, other than by commercial negotiation with Iona, save as provided in Clause 7 below.

Iona will agree to make binary licences for the revised code or release of ORBIX available on favourable and reasonable commercial terms to the other sponsors who have participated in the ANSA Work programme for the period of the duration of the work and who were qualified to benefit from such results at said time.

In the event that Iona decides not to productise the results of the work or fails to productise the results within two (2) years of its completion then it shall

promptly advise APM of such decision or event and in either case APM then shall be free to release all results to other sponsors, but always provided that such release does not imply release or free licensing of ORBIX code.

6.7 Anti-trust

Within the first six months of the work any other sponsor which has a suitable CORBA may ask to participate in the work, provided it makes an equal contribution of effort, software, tools and (if appropriate) finance, where such contribution shall be equivalent to that sponsor having participated in the work from the commencement, including any time spent in false starts or erroneous development. The same confidentialities shall apply and both CORBAs shall be subject to individual source code non-disclosure agreements so that Background IPR does not flow from one to the other.

In this situation, if it is found that one CORBA has significant advantages over the other, then this shall not be used to the advantage or enhancement of the inferior one.

APM shall have the right to reject any CORBA which is seriously deficient (“not suitable”) provided it gives good technical reason for the decision.