AC003
VITAL
Validation of Integrated Telecommunication Architectures for the Long term

Final Report

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1. Executive Summary

After three years of specification, implementation and trials the ACTS project AC003 VITAL has finished in October 1998. In the course of its existence VITAL has produced a wide variety of results —both material and less tangible— that will continue to be used beyond the end of the project.

The overall objective of VITAL was to develop, implement, demonstrate, and validate an Open Distributed Telecommunication Architecture (ODTA) for deploying, managing and using a set of heterogeneous service features, in particular multi-media, multi-party, and mobility services.

The ODTA was challenged in trials by means of a Teletraining application suite that answers the requirements of real stakeholders. In these trials the ODTA was validated in terms of reusability, extendibility and scalability of the identified components. The ODTA components were implemented and tested on available distributed object oriented technology.

The approach of the project has been a pragmatic one. The approach was not to develop ODTA concepts from scratch, but to re-use work already carried out in this area. VITAL considers the Telecommunications Information Networking Architecture (TINA) as the most important input for the ODTA definition and extends and refines it to provide the selected service features. Possible gaps and inconsistencies are resolved using input from areas such as Intelligent Networks (IN), Telecommunications Management Networks (TMN) and previous EG RACE work such as the Open Service Architecture (OSA).

VITAL used a phased approach to reach its objectives.

Phase 1 (Nov'95-Oct'96): A first version of the ODTA components and a limited set of service features were defined, implemented and demonstrated in a first trial. Access to the service features was provided through basic user interfaces. The trial was limited to one national host (Spanish) and did not involve any end-user communities.

Phase 2 (Nov'96-Oct'97): A refined version of the ODTA components and the extended set of service features -covering all multi-media, multi-party and mobility aspects- were defined, implemented and demonstrated in a second trial. A complete implementation of the Teletraining application was provided. In addition, the trial now included the Italian, Spanish, Belgian and Portuguese national hosts, interconnected over an international broadband network (JAMES).

Phase 3 (Nov'97-Oct'98): The final version of the ODTA components and an extended set of applications were defined, implemented and demonstrated in a third trial. In addition to basic functionality the third trial demonstrated interworking of the ODTA with Internet, ADSL access networks, IN and TMN. There were five independent national host sites involved.

All three VITAL phases have been concluded with success. VITAL has demonstrated a Teletraining application suite, featuring Desktop Audio/Video Conferencing, Chat, Slide Presentation, Shared Whiteboard, Digital Library and Juke Box applications. The demonstrators further show that the VITAL ODTA is capable of supporting personalisation of services and on-line administration of new subscribers. The integrating architecture, the ODTA, runs on top of a truly heterogeneous transport network consisting of ATM, Internet and ISDN equipment of different manufacturers.

VITAL proves that the TINA-based architecture like the ODTA can indeed act as a virtual market place for telecommunications services. This includes support for multiple co-operating and competing service providers through a federation mechanism.

The end result of VITAL consists of specifications, running code, deliverables, and a demonstrator. However the project has also produced results in the form of working practices, implicit design patterns and a working spirit among the participating partners. In the long term, these results will prove at least as important as the more ‘measurable’ project results.
2. Objectives

The overall objective of the VITAL project was to demonstrate and validate the development, deployment, management and use of complex heterogeneous service features on an Open Distributed Telecommunication Architecture (ODTA) defined in terms of reusable components.

The project did not aim to investigate new ODTA concepts, but to refine and extend the Telecommunications Information Networking Architecture (TINA) to support the target service features, taking into account inputs from Telecommunication Management Network (TMN), Intelligent Network (IN) and related RACE results, such as Open Services Architecture (OSA).

The ODTA was validated and demonstrated in a number of trials involving several National Host sites, interconnected by a pan European ATM network. In these trials the ODTA was demonstrated by a set of applications that use the ODTA multimedia, multi-party and mobility features. These applications were presented as part of an integrated tele-training application suite.

The validation criteria for the ODTA were designed to assess the validity of the ODTA itself, but also to demonstrate that the ODTA can interwork with Internet, IN, TMN and ADSL access networks. Both operational and management aspects of these services were demonstrated. The trials involved all relevant stakeholders, including the service end-user, service subscriber, service developer, service provider and network operator.

One of the important goals of VITAL was to apply TINA technology, but also to influence the on-going TINA-C definition process. Apart from TINA, VITAL targeted other relevant standardisation fora like the OMG and UMTS Forum.
3. Relationship with the Programme

The major focus of the VITAL project was on task AC504 *Modular Integrated Telecommunication Services Trial* and task AC507 *Open Service Execution Infrastructure Trial*.

VITAL addressed the following objectives of task AC504:

- to define a representative set of telecommunication services in terms of reusable service components/interfaces, and their associated network control components/interfaces and management components/interfaces,
- to validate, using case studies, the use and management of these telecommunication services,
- to implement these service components,
- to try the use and management of these telecommunication services in a field trial environment.

VITAL addressed the following objectives of task AC507:

- to further refine and extend the definition of the architecture of an open service execution platform,
- to establish consensus on the definition and contribute towards promoting its uptake,
- to implement prototypes of the platform,
- to try the interworking between applications supported by 2 or more service execution platforms.

Tasks addressed with minor priority were:

- AC501 Multi-media Communication Space Trial,
- AC506 Competitive Service Machine for a Service Application Trial,
- AC511 Service and/or Feature Interaction.

Relationships with other projects

VITAL has had a close working relationship with the projects DOLMEN (AC036), ReTINA (AC048), and SCREEN (AC227). The interconnection services of the JAMES (AC111) project have been used in VITALv2. The following are the key co-operation points:

- **DOLMEN (AC036)**: as VITAL, this project aims at providing, demonstrating, assessing and promoting a service architecture that meets the requirements of open provisioning of communication services over both fixed and mobile heterogeneous and multi-provider telecommunication networks. DOLMEN is very much oriented towards the issue of mobility in TINA like environments, and so both projects are to a large extend complementary.

- **ReTINA (AC048)**: this project develops an industrial-strength, TINA-compliant distributed processing environment together with a set of associated application development tools and a set of service demonstrators implemented on the project’s DPE. VITAL and ReTINA share experience on ‘developing applications on a DPE’.

- **SCREEN (AC227)**: this project aims to define and demonstrate service creation environments (SCEs) targeted to specific service architectures and to distributed processing environments, such as TINA. The collaboration between VITAL and SCREEN is materialising in two directions: VITAL uses the SCREEN SCE to specify and implement its architecture, while SCREEN is using the VITAL platform as a target environment on top of which it creates Trial services. A close collaboration between the two projects exists, as SCREEN has built an SDL model of the VITALv2 architecture for service engineering purposes, and SCREEN methods and tools have been used in the specification of VITALv3.

- **JAMES (AC111)**: this project provides services for international ATM connections (between National Host infrastructures). VITAL interconnected its National Host sites in the second Trial, using the interconnection services from the JAMES project.

The activities and results of ACTranS (AC081), MISA (AC080), PROSPECT (AC052), EXODUS (AC013), INSIGNIA (AC068), TOSCA (P106), and ABS (AC206) are monitored. Part of the collaboration with the above mentioned projects are conducted within the concertation mechanisms provided by ACTS. In the case of SCREEN and ReTINA, collaboration takes place on a direct bi-lateral basis.

Participation in Domains, Chains and Clusters

VITAL was a member of the Domain 5 on *Service Engineering, Security and Communications Management*. VITAL chaired the Cluster on *Service Engineering and Mobility*, of which the projects ReTINA, DOLMEN, ACTranS, EXODUS, SCREEN, TOSCA, ABS, COBRA, OSM, Dolphin and Difference are part. VITAL has contributed to several SIA Guidelines. These contributions are always centred around the ODTA and the TINA architecture.

VITAL edits a chapter on Architectures in the IS&N Book, produced by the DOLPHIN project and to be published in 1999.
In February 1998 VITAL had a prominent role in the organisation of the ACTS-TINA workshop. The workshop was co-chaired by the TINA-C Chief Technical Officer and the VITAL project manager.

VITAL was a driving force in the organisation of both the IS&N’98 and IS&N’99 conferences, held in Antwerp and Barcelona, respectively. The VITAL consortium delivered the Conference Manager and the Technical Programme Committee Chairman to these respective conferences.
4. Main Achievements

The overall objective of the VITAL project was to develop, implement, demonstrate, and validate an Open Distributed Telecommunication Architecture (ODTA) for deploying, managing and using a set of heterogeneous service features, in particular multi-media, multi-party, and mobility services. The ODTA was challenged in trials by means of a Teletraining application suite that answers the requirements of real stakeholders. In these trials the ODTA was validated in terms of reusability, extendibility and scalability of the identified components. The ODTA components were implemented and tested on available distributed object oriented technology. VITAL has given feedback to related standardisation bodies, other consortia in ACTS, and TINA-C.

In the three years of its existence, three phases of VITAL have been successfully completed. In these phases three subsequent versions of the VITAL architecture, VITALv1, VITALv2 and VITALv3, has been specified, implemented and demonstrated with success.

VITALv1 has been able to show a Desktop Video Conferencing application, a Subscription Management, a Resource Configuration Management application, and a Monitoring Tool that shows the internal interactions of the architecture in real-time. All these elements were integrated in the Open Distributed Telecommunications Architecture (ODTA), which ran on top of ATM switches of different manufacturers.

VITALv2 extended the VITALv1 architecture with an integrated tele-training kernel and additional applications including Shared Whiteboard, Slide Presentation and Web-access to subscription management. Moreover, VITALv2 was demonstrated over an international ATM network of four interconnected National Host sites (Belgium, Italy, Portugal, Spain).

VITALv3 added to this an implementation of the Retailer-to-Retailer federation interface, allowing services to be delivered across service provider domains. VITALv3 also demonstrated that the ODTA can interwork with Internet, ADSL access networks, IN and TMN systems. An extensive collection of new tele-training services were implemented for VITALv3. Some of these new services can be downloaded from simple Personal Computer with a Java enabled web-browser, showing the possibility to access ODTA services from simple Internet based terminals.

The main components that were implemented and validated in the three phases will be examined more closely in the following sections.

Definition and implementation of the ODTA

The main achievement of VITAL has been the specification and implementation of the Open Distributed Telecommunications Architecture (ODTA). The VITAL ODTA components are fully specified in VITAL Deliverable D13, entitled “ODTA Validation 3rd Trial”. This deliverable highlights the main refinements, extensions and simplifications that VITAL has introduced with respect to TINA. The content of D13 is considered of great value to TINA-C, as it completes and refines the TINA architecture from implementation based experience. It has been used as a contribution to several TINA-C Work Groups.

The VITAL Open Distributed Telecommunications Architecture (ODTA) will be described in more detail in the following paragraphs.

VITAL Overall Architecture

The VITAL ODTA is mainly based on the Telecommunications Information Networking Architecture (TINA). VITAL expands, complements and refines the TINA specifications as required by the implementation.

The VITAL ODTA consists of a number of subsystems which represent functionally non-overlapping parts of the system. Each subsystem is implemented by a number of components. An ODTA component consist of a set of interfaces, each grouping a set of operations, and the code implementing these operations. The interfaces are defined in the Interface Definition Language (IDL) standardised by the Object Management Group (OMG).

The ODTA components run on top of a Distributed Processing Environment (DPE) which provides a homogeneous view on a heterogeneous computing environment. The CORBA 2.0 compliant DPE selected for VITAL is IONA’s Orbix MT 2.3. The DPE kernels are interconnected by means of a Kernel Transport Network (KTN) over TCP/IP. The KTN can be seen as the TINA equivalent of a signalling network.

1 The Retailer is a TINA business role. It represents the one-stop shop for services from the consumer point of view. Outside TINA this business role is most often called the “service provider”. TINA however explicitly chose the term Retailer in order to make the split between service and network provisioning clear.

2 This report assumes the reader to be acquainted with the main TINA principles.
VITAL covers the most important TINA business domains: the consumer, retailer and connectivity provider. In addition, VITAL added the terminal provider domain which did not previously exist in TINA. VITAL implemented several TINA compliant reference points between these business roles: Ret, RtR, ConS and Tcon. Two new reference points were implemented for the terminal provider: T-Ret and T-User.

Figure A1.2 shows the subsystems and applications developed in VITAL and their relationships. The supported TINA inter-domain reference points are also represented. The consumer domain subsystem contains the ODTA components that are run in the user terminal. Unlike in TINA, the VITAL consumer domain is split in a user domain and a terminal provider domain. Between these is a new reference point, called T-User.

In VITAL, the retailer domain contains the access session subsystem, the service session subsystem, the subscription management subsystem and the discrete terminal mobility subsystem. The connectivity provider domain contains the connection management subsystem and the resource configuration management subsystem. Each of these subsystems has one or more associated applications that allow the validation and demonstration of its features.

**VITALv2 ODTA Subsystems**

Following TINA definitions, the ODTA can be divided in three sub-architectures: the computing architecture, the service architecture, and the network resource architecture. The computing architecture provides the Distributed Processing Environment (DPE) its services which are described in VITAL deliverable D09 “DPE and Methodologies+Tools”. The VITAL service architecture consists of the subsystems in the retailer domain and the VITAL network resource architecture contains the subsystems in the connectivity provider domain.

As the only exception, the Communication Session Manager (CSM) component belongs to the network resource architecture, but resides in the retailer domain. It serves as the link between the service architecture and the network resource architecture.
The VITAL architecture consists of the following subsystems:

- **Access Session Control Subsystem** is part of the ODTA Service Architecture and handles the access sessions. An access session represents a trusted relation between one consumer and one retailer. VITAL supports a wide range of possibilities: multiple consumers having access sessions on the same terminal, one consumer having access sessions on multiple terminals, and one consumer having access sessions on one or more terminals with different retailers. The access session control subsystem consists of a component in the consumer domain: the Retailer Applet or Provider Agent (PA); and several components in the retailer domain: the Initial Agent (IA), the User Agent (UA), the User Agent Factory (UAF), the Announcement Manager (AM) and the Peer Agent. The latter is responsible for the federation between retailers.

- **Service Session Control Subsystem** is part of the ODTA Service Architecture and manages the user and service sessions. It contains two components: Service Factory (SF) and Service Session Manager (SSM). The SSM can be seen as the core of an ODTA session, and consists of a generic part and a service specific part. The generic part the is called Global Session Control (GSC), and contains the service common operations for managing parties, connections and session ownership. The service specific part, the Global Service Segment (GSS) contains any additional service logic that is specific to a particular application. For each service that is started, exactly one GSC and GSS are instantiated. If more than one retailer is involved (federation), one GSC and one GSS is started in each of the retailer domains. The GSS components are described in more detail in VITAL deliverable D15, entitled “Description of the 3rd Trial”.

- **Subscription Management Subsystem** is part of the ODTA Service Architecture and allows the management of subscriptions, service profiles and service templates. It consists of a Subscription Agent (SubAg) component per subscribed user and terminal, a Service Template Handler (STH), a Subscriber Manager (SubM) and a Subscription Register (SubRg). Apart from the direct interface offered to these components, VITAL allows end-users to access the subscription data through a normal service session. This is referred to as on-line subscription. As on-line subscription can be considered a service, it required a service specific GSS to be defined (see above).

- **Discrete Terminal Mobility Subsystem** is part of the ODTA Service Architecture and allows the provisioning of discrete terminal mobility and remote user registration. The functionality of terminal mobility is explained in more detail in the next section on trial applications. This subsystem contains two components in the consumer domain: the Terminal Controller Front End (TCFE) and the Terminal Controller (TC), and two components in the retailer domain: the Terminal Mobility Manager (TMM) and the Terminal Agent (one per registered DTM terminal). A new business role is defined for discrete terminal mobility: the terminal provider.

- **Connection Management Subsystem** is part of the ODTA Network Resource Architecture and provides connectivity services to the retailer domains. It contains a Communication Session Manager (CSM) which handles the retailer’s requests for connectivity, and its counterpart in the consumer domain: the Terminal Communication Session Manager (TCSM). The connections themselves are set up in a layered manner, using a Connection Coordinator (CC), a Layer Network Coordinator for IP (LNC-IP) and one for ATM (LNC-ATM), and their counterparts in the consumer domain: the Terminal Layer Adapters for IP and ATM (TLA-IP and TLA-ATM). At the level of physical connections, each ATM subnetwork uses Connection Performers (CPs). The lowest level CPs that interact directly with the switches are called Element Management Layer CPs (EML-CP), the other CPs are called Network Management Layer CPs (NML-CP). The proprietary switch interface is hidden by a Resource Adapter (RA) component which allows the EML-CPs to be vendor independent.

- **Resource Configuration Management Subsystem** is part of the ODTA Network Resource Architecture. It creates and maintains network resource maps for ATM virtual circuit (VC) layer networks, and supports configuration management of the connection management subsystem. The resource configuration subsystem is composed of a Network Topology Map (NTMap), a Management Configurator (MC) and a Connection Management Configurator (CMC) for the ATM VC layer. The CMC is in charge of launching the relevant components of the CMS subsystem via their configuration interfaces.

- **Fault Management Subsystem** is part of the ODTA Network Resource Architecture and provide means to detect, locate and correct abnormal behaviour of the components in the ODTA connection management subsystem (the LNC-ATM, NML-CP, EML-CP and RA components described above). It is composed of the Testing/Diagnostic Server (TDS), the Alarm Manager (AlarmM) and a Fault Co-ordinator (FC). This subsystem uses the DPE Notification Service developed in VITALV2 to distribute the alarms. Unlike the other sub-systems, the ODTA fault management subsystem was only specified, but not implemented.
Trial Applications

To validate and demonstrate the ODTA, VITAL implemented a set of applications. VITAL produced applications for all business domains in order to cover the entire scope of the ODTA:

- **End-user applications**: these are applications in the usual sense of the word, targeted at the consumer and running on the consumer’s terminal. They include access services (web-access, discrete terminal mobility, teletraining kernel), a desktop video & audio conference, chat, jukebox, slide show, digital library, net meeting and Internet conference applications.

- **Management applications** allow the retailer and the network provider to manage subscriptions and network resources.

There are two types of end-user services:

- **Platform independent, down-loadable** applications can be accessed from any terminal with a Java enabled Web browser, like a standard PC. These applications use only standard terminal capabilities and do not require a specific hardware configuration. Examples of these applications are chat, slide show and digital library.

- **Platform dependent, pre-installed** applications require special terminal capabilities like audio/video hardware, ATM or ADSL termination points. These applications cannot be down-loaded from the Internet and must be pre-installed in the terminal together with the required hardware. Examples of these applications are desk top audio/video conferencing and net meeting.

In the following paragraphs, each of the services developed in VITAL are briefly described.

**Access applications**

The most important access application developed in VITAL is the Teletraining (TT) application suite. The Teletraining application suite provides a framework for accessing a group of services that represent a ‘virtual campus’, including audio-video conferencing, shared white board and slide presentation. In VITALv2 this access was mostly through pre-installed software on workstations with special hardware capabilities. In VITAL, the Teletraining application suite was extended to allow Web based access from standard terminals (like personal computers). The main objective in VITAL was to evaluate the integration of CORBA and JAVA technology in providing Web-based access to services and subscription data.

When services are accessed through the web interface, the following steps are involved:

1. Access is initiated by down-loading and running a Java applet, referred to as the "retailer applet".
2. The retailer applet allows the user to log in with a retailer, i.e. starting an ODTA access session.
3. Within the access session a number of features are available through the Web interface:
   - list the available or specifically subscribed services,
   - list the announced active service sessions that the user can join,
   - list invitations to service sessions that have been sent to the user, and that he or she may join,
   - list the service sessions the user is currently involved in; leave or stop one or more of these service sessions,
   - list the access sessions the user is currently involved in; leave or stop one or more access sessions and related service sessions,
   - remote register a user to one or more terminals to receive invitations (even if the user hasn’t previously established an access session on that terminal).

**Desktop Video Audio Conference (DVAC)**

Desktop Video Audio Conference (DVAC) is a platform dependent pre-installed application that allows a user to manage audio and video connections between several parties. The objective of the DVAC application is to demonstrate all standard features of the TINA service session for managing parties and connections. The DVAC application is essentially a user interface to a standard service session; it does not involve any service specific logic in the network.

The user creates a new DVAC session or joins an existing session through the access session. Once the DVAC service session and its user interface are started, the user can invite users to the audio/video conference, remove users from the session, create several types of connections between the existing participants, add and remove participants from a connection, and change control of the session, participants and communications.
In VITALv2, the DVAC audio and video connections were set up over ATM layer networks, and there was no control over the quality of service. The extension made in VITAL allows a user to select the quality of video. Depending on the selected quality, the connections are set up over ATM (high quality: higher frame rate, bigger picture) or over Ethernet (low quality: lower frame rate, smaller picture). In line with TINA principles, the selection of the transport medium is entirely transparent to the application. In other words, at application level the only visible distinction is between “high” or “low” quality.

In addition, the DVAC user interface has significantly improved in VITAL. The VITAL now offers a simple, user friendly interface that is easy to adapt to specific application areas such as tele-learning or tele-medicine.

**Chat**

Chat is a platform independent, downloadable application that supports a real-time text based conversation between several parties. The chat application user interface consists of a window with two areas: a “local” area where the user can type his or her message to the rest of the participants, and a “public” area where all the messages appear. Each message appearing in the “public” area is tagged with the identity of the sender.

Apart from the “public” chat conversation, each party has the possibility to open a “private” chat conversation with any other party. The interface of a “private” chat session is essentially the same as the “public” chat window, except that only the addressed party can see the messages typed.

The chat application does not use Connection Management services. It relies upon the Distributed Processing Environment to carry the text strings typed by the parties. The chat application was implemented to demonstrate the ease with which new downloadable services can be created as extensions of the generic service session.

Summarising, each party in a chat session can:

- receive and transmit ‘public’ messages (public conversation),
- receive and transmit ‘private’ messages (private conversation),
- keep track of the whole conversation, where each string is tagged with its sender and a time stamp.

The chat service offers the following management features to the retailer:

- start and stop a chat session (only the retailer can do this, not the participating parties),
- add and delete parties in a chat session.

**Jukebox**

Jukebox is a platform independent, downloadable application that allows a user to browse, download and play audio files. Like chat, the jukebox application was implemented to demonstrate rapid creation of downloadable services. The files accessed by the Jukebox application can contain any kind of audio information, be it speech or music.

When a retailer starts a Jukebox session, it must specify the audio files that are offered by that session. The users that join the Jukebox session can:

- retrieve and browse the list of audio files in the session
- download and play any of the audio files on offer

After a file is retrieved it is played using a Java sound player. This allows playing audio files independently of the computing hardware and without the need of special plug-ins, using just the `http` protocol and the `URL` of the file. The retailer can modify the audio file offer at any time during the session, and any modifications will show up in real-time in the interface of any party connected to the session.

**Slide Show**

Slide show is a platform-independent, downloadable service that allows a group of users to jointly view a set of images. The slide show is controlled by a ‘conductor’ who can step forward and backward through the images. Other users that join a slide show session can view the slides that the conductor is showing. The conductor is by default the party that starts up the slide show session. At any time during the session the conductor can pass control of the slide show to another party, making that party the new conductor. The owner of the session (i.e. the party that started the session) can always intervene however, and resume control of the session.
The image files shown in a slide show originate on the local hard disk of the session owner. The slides are transferred to the other parties using the ftp protocol. It is possible to open different sets of images within one slide show session. The conductor can show the images sequentially or jump to a certain image. The slide show application further allows zooming in on part of an image.

The slide show application was implemented to demonstrate the TINA concept of session ownership. It shows how ownership of a session can be defined by default (by starting a session), and how it can be re-defined (by passing control to another party). Furthermore, it is another example of a service that can be downloaded from the Web on a generic terminal without special hardware or software pre-installed.

**Digital Library**

The digital library is a platform independent, downloadable application that offers a ‘virtual library’ of multimedia documents to its users. The digital library application contains features for two kinds of users: library providers and end-users. The party that starts the session is the library provider. The library provider can create a new library, load an existing one from file and modify library contents.

End-users can join a library session, browse its contents, and ‘borrow’ artefacts. When an artefact is ‘borrowed’ its data is transferred to the end-user's terminal and can then be processed locally. What distinguishes ‘borrowing’ from plain downloading is that the digital library session records which artefact is taken out and returned when. This allows for administering and charging the usage of the library, for example as a means of respecting authors' rights. The library provider can also restrict the number of artefacts that can be borrowed by each party at any time. Borrowed artefacts are processed locally on the terminal by MIME-type recognition capabilities of the browser. This allows displaying the data in an appropriate way.

The library provider can modify the contents of the library at any time, and the changes are reflected in real-time in the interface of the user.

The digital library was implemented as an example of a realistic service for a tele-education framework. Moreover, it shows the full extend of Java powered downloadable services that can operate on standard terminals with only a Java enabled browser.

**Microsoft NetMeeting**

VITAL NetMeeting is an adaptation of existing commercially available applications for audio/video conferencing over Internet. It consists of the Microsoft ® NetMeeting ™ for the two-party conferencing application, and the WhitePine™ MeetingPoint MCU for multi-point support. Both are commercial applications based on the ITU H.323 standard.

From a purely functional point of view, the NetMeeting application is similar to the Desktop Video Audio Conference (DVAC) application described above. However, the VITAL NetMeeting adaptation shows that it is possible to integrate existing Internet applications in a TINA compliant framework. At the end-user side, the existing applications are fully reused, while a TINA compliant session control, which is the network side of the service. This shows that TINA can add value to existing Internet applications, for example by making them chargeable and by allowing control of session ownership.

**Internet Conference**

Internet conference is an application that was not developed specifically in VITAL, but which has been adapted from another Framework project called MECCANO. The Internet conference demonstration uses a set of applications developed in the COIAX project.

The applications used for demonstration purposes are ‘VIC’ a packet video application, ‘RAT’ a packet audio application, ‘NTE’ a shared editing application, and ‘WB’ a shared white board application. These are multi-way conferencing tools that normally operate over IP multicast. They can however also run in unicast mode, communicating with a Transcoding Gateway (TG) in the access network.

From the main application Internet conferences can be created, announced, and users can be invited to the session. The main applications also starts the media applications VIC, RAT and NTE mentioned above.
Discrete Terminal Mobility

The discrete terminal mobility application demonstrates that the ODTA supports the Virtual Home Environment (VHE) concept. It allows users to move terminals from one network termination point to another, and register the terminal for use at the new termination point. Moreover the discrete terminal mobility application ensures that a user’s subscription and service profiles are associated with the new terminal address.

Discrete terminal mobility also allows users to remote register on terminals, and will notify a terminal each time a registration is made to it. The terminal owner can establish conditions on the maximum number of (remote) user registrations in the terminal.

Note that it is only possible to move a terminal in between access and service sessions, not during a session. For this reason, this type of mobility is referred to as discrete terminal mobility as opposed to full mobile telephony which requires hand-over techniques.

The discrete terminal mobility concept involves a new business role not previously existing in TINA, the terminal provider. This role is further explained in the section on the ODTA above.

Subscription Management

Subscription management is an application for the retailer domain. It allows the retailer or service provider to manage the relationship between services and users. This includes subscriptions as well as service templates and service profiles. A subscription specifies which services can be used by a specific set of users. Service profiles and service templates respectively define pre-defined service packages and specific service settings for a group of users.

The subscription management application offers a user friendly interface to creating, deleting and modifying subscriptions, templates and profiles. The subscription application can be accessed in two ways:

- directly through a user interface on a retailer terminal,
- indirectly via a service session (using an interface that can be downloaded on a Java enabled browser).

The subscription management application demonstrates that VITAL applications can also be delivered to the retailer (service provider) domain. It also demonstrates two different modes of subscription management: off-line and on-line.

Resource Configuration Management

The resource configuration management application allows the network provider to manage the topological networks and resources in its domain. It offers a user interface through which a network provider can create, delete, query and modify resource configurations.

The objective of the resource configuration management application is to demonstrate that VITAL applications can also be delivered to the network provider domain. More about resource configuration management can be found in the section on the ODTA above.

Interworking with legacy systems

In addition to the specification, implementation and integration of the ODTA core subsystems and applications, VITAL included a number of activities to demonstrate the capability of the ODTA to interwork with legacy systems:

- **TINA-Internet synergy at service architecture level** to demonstrate that the ODTA can add value in the creation and provisioning of services on top of an ‘Internet’ transport layer. Using the Microsoft Net Meeting application as test case, this activity shows that the TINA service session can be introduced in an environment of software applications distributed between clients, and an Internet server relying on IP-based communication. More about this activity is said in relation with the Net Meeting application under the trial applications section.

- **TINA-Internet synergy at network resource architecture level** to investigate how ODTA connection management can be used with existing IP-Multicast based services. Three new interworking components have been developed for this purpose: Access Point Communications Session Manager, Access Point Layer Adapter and Access Point Application Adapter.

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3 Virtual Home Environment is a term used often in the context of third generation mobile communications, in particular UMTS and IMT2000.
• CORBA-IN interworking, investigating how to introduce ODTA distributed object oriented concepts into IN as an enabling technology for service provisioning. The main focus of this activity was to define and implement an INAP-CORBA gateway. Two prototype services have been created on a CORBA based IN platform: a Time Dependent Routing (TDR) service and a Call Screening (CS) service.

• TMN-TINA migration to analyse several evolution scenarios and to integrate the VITAL prototype with a network management platform based on Alcatel’s NM Expert environment.

• TINA management of an ADSL access network, developing a resource adapter for an ADSL rack. The objective of this experiment was to show that ADSL access networks can be integrated in the ODTA network resource architecture. In the VITALv3 trial, one of the terminals was connected to the ATM network via ADSL access, rather than directly through fibre. A SMNP-CORBA compiler was developed in this activity to ease the implementation of said resource adapter.

Furthermore, integration support was given for distributed processing environment services and tools: porting and testing the authentication service, the notification service and the monitoring facility on Orbix 2.3.

Validation trials

VITAL has used an iterative approach to the specification, implementation and validation of the ODTA. Three major cycles were completed, each ending in a trial and demonstration.

The first VITAL trial VITALv1 (October 1996) involved two independent National Host sites in Spain and Italy, respectively. In the second trial VITALv2 (October 1997), four National Host sites (Belgium, Italy, Portugal, Spain) were interconnected using the ATM network provided by the AC111 JAMES project. The VITALv3 trial (October 1998) focused on interworking issues, and involves five independent trial sites in Belgium, Italy, Portugal, Spain and the United Kingdom.

In the phase leading up to each trial, the components were first implemented individually and then integrated with those belonging to the same subsystem. Finally, the different subsystems were integrated to compose the overall VITAL ODTA. Each trial consisted of a validation and demonstration phase. An extensive set of validation scenarios was used in the validation phase to test the software and the intended functionality.

During the VITALv2 and VITALv3 validation trial, it became clear that the system had improved significantly in stability with respect to earlier versions. This lead the VITAL partners to conclude that the extensive re-use of tested components from earlier phases had paid off. It also boosted the project’s confidence in the phased approach leading from VITALv1 to VITALv3 in three iterations.

With the validation trials accomplished, VITAL has proven the feasibility of a TINA based open service architecture. The VITAL ODTA has proven that it supports a wide range of multi-party multi-media services, in a heterogeneous environment of multiple retailers and network providers. Moreover, the ODTA has shown that the concept of services can be applied to all stakeholders in the TINA business model: end-users, retailers and network providers alike.

Demonstrations of VITAL were given on December 3, 1997, at the IS&N’98 conference in Antwerp in May 1998, and on 16th November 1998. VITAL is still demonstrated to external parties on a regular basis.
5. Main Conclusions from the VITAL Work

The overall objective of the VITAL project was to develop, implement, demonstrate, and validate an Open Distributed Telecommunication Architecture (ODTA) for deploying, managing and using a set of heterogeneous service features, in particular multi-media, multi-party, and mobility services. The ODTA was developed and validated in three consecutive phases of one year each. Each phase ended in a trial in which the ODTA was validated in terms of reusability, extendibility and scalability of the identified components.

The VITAL work has been very strongly linked to that of the Telecommunications Information Networking Architecture Consortium (TINA-C). The specifications of the TINA Consortium were the main input to VITAL, while in turn VITAL has proven itself one of the most important TINA auxiliary projects, giving feedback to TINA-C based on the implementation and validations done within the project.

All three VITAL phases have been concluded with success. VITAL proves that the TINA-based architecture like the ODTA can indeed act as a virtual open market place for telecommunications services, using heterogeneous transport technologies. One of the most important features of the ODTA is that it enables services to be provisioned in an environment of multiple cooperating and competitive network and service providers. VITAL has implemented reference points for federation both between Retailers and between Connectivity Providers. The implementation of such interfaces is of paramount importance for future service platforms in a world where communications are opening to competition.

The ODTA components were implemented and tested on distributed object oriented technology that is available on the market today. The inter-object communications in VITAL were based on the Object Management Group (OMG) CORBA standard, and the product used a commercially available implementation of a CORBA based Object Request Broker and services. Although the maturity of CORBA products have proven to be satisfactory for a prototype, it remains to be seen whether it is possible to build industry-strength telecommunications platforms with today’s CORBA technology.

The VITAL experience has proven the great extent to which TINA implementations are re-usable. Although the specifications evolved between VITALv1 and v3, much code was re-used from one prototype to the next. As VITAL is based on object oriented principles, the code is modular and relies upon inheritance. This has much improved the re-use of modules from one prototype to the next. Generally speaking, about 70% of the code developed for one phase was re-used in the next. It is expected that many of the modules developed in VITAL will be re-used beyond the duration of the project, even if the system as a whole may become obsolete with time.

The incremental approach used in realising the VITAL prototype in three steps (VITALv1-v2-v3) has proven to be very effective. The stability of the platform dramatically improved with each VITAL phase. Moreover, the specification and development cycle became shorter with each iteration. This has been a direct result of the re-use of code and experience from the earlier phases. The phased approach has been of much benefit to VITAL, and has ensured that the development process remained manageable. In fact all VITAL milestones were met and all deliverables were delivered on time.

The measurement of performance of the ODTA was outside the scope of the VITAL project. The VITAL demonstrator involved only about 10 terminals, and it is very difficult to extrapolate conclusions on performance from this. However in the course of implementing the VITAL prototype, confidence has grown that the ODTA architecture itself does not present performance limitations. Of course the performance is influenced by a number of factors, the most important being the performance of the CORBA based middleware and a number of engineering choices. Important engineering choices include the object granularity, multi-threading support, data storage and retrieval, etc. Significant work is still to be done in tuning these parameters in order to obtain a scalable system.

In the end, perhaps the most important VITAL result is the collective experience gained in specifying and implementing an open distributed telecommunications system. VITAL has probably the world’s leading experience in implementing TINA specifications. The project claims to have contributed to managing the complexity of telecommunications and information technologies and putting them at the service of the user. The VITAL trials and demonstrations provide the witness to this claim. The challenge is now to take advantage of the knowledge built in VITAL and put it into products.
6. Inputs to Standards and Guidelines

Guidelines
Together with the DIFFERENCE project, VITAL has taken the initiative to propose a set of guidelines to the SIA Chain:

- **G1** - Consolidation of a common reference service architecture for global service integration - A Comparative analysis,
- **G2** - Requirements on distributed service infrastructure - Issues for Multimedia Quality of Service,
- **G3** - Enterprise models for service provisioning - Common Reference Model,
- **G4** - Deployment and provision of services in an open environment distributed service - Technology Supporting Service Contracts.

Of these four, VITAL has contributed actively to **G1**, and has reviewed all other guidelines.

In 1998 VITAL has provided a contribution to the SII/SIA guideline **G7**: “TINA Concepts for Multimedia”. This contribution covers TINA-Internet synergy and the implicit stream binding mechanism proposed by VITAL.

VITAL also prepared a contribution for SIA Guideline **G3**: “Enterprise Models of Electronic Brokerage”. Due to timing constraints the VITAL contribution was only partly included in the guideline, however. A more complete contribution, on brokering mechanisms in the ODTA and TINA, has been made to Guideline **G6**.

VITAL has made a contribution on Personal and Terminal Mobility to Guideline **NIF-G3** “Aspects of Service Architectures in an Integrated Fixed and Mobile Environment”.

**TINA-C**

TINA-C specifications formed the most important input for VITAL specification and implementation work while the experience gained in VITAL in turn influenced the TINA-C specifications.

The VITAL consortium has had close linkage with TINA-C through partner participation in the TINA-C core team. Bell Telephone, Alcatel SESA, CSELT, Telefonica, Portugal Telecom, AAR, and IONA are TINA-C members and have had people working in the core team. Since the TINA-C core team was dismantled end 1997, these VITAL partners continued to have people contributing to the Working Groups. They were actively involved in the review process of the TINA-C deliverables, basing their comments on their experience gained in the VITAL project.

VITAL was recognised as a TINA-C auxiliary project. This gave the TINA consortium the right to look into the results of VITAL, while the VITAL consortium, including the VITAL partners that were not TINA Consortium members, had access to all material, even drafts and engineering notes, produced by the TINA core team.

The VITAL Service Architecture (SA) was based on the TINA SA v5.0 (January 1998), although VITAL had to make a number of refinements to actually come to an implemented system. This experience has been used to contribute significantly to the TINA Retailer (Ret) reference point specification and the TINA Service Component specification. The VITAL Subscription Management subsystem is also based on the TINA SA v5.0.

The TINA Network Resource Architecture (NRA) v3.0 (February 1997) has been an important input for the VITAL Connection Management (CM) subsystem. VITAL has had to refine and complete these specifications as they contain many under-specified components. The Network Component Specifications v 2.2 has also been a key input to the VITAL CM subsystem. The TINA-C Network Components Specifications is itself the result of input from the earlier phases of VITAL. The Resource Configuration Management subsystem is based on the TINA Network Resource Configuration Management v2.0 (October 1996).

The VITAL DPE and its services are in line with the OMG standards whenever possible. The DPE selected for VITAL follows the CORBA 2 specifications. The Transaction and Concurrency Control Services are CORBA compliant. The design of the VITAL Notification Service has strongly influenced the OMG RFP (Request For Proposal) for a Notification Service.

The following paragraphs explain in more detail the influence that VITAL has had on TINA Work Groups and other fora.
TINA Service Architecture Reference Point Work Group

The TINA-C “Ret Reference Point Specifications” (Version 1.0, 27 January 1998) and “Service Component Specifications” (Version 1.0b, 19 January 1998) have been used as the main input for the specification of the access and service session subsystems. VITAL has introduced a number of refinements where these specifications proved to be ambiguous or inadequate. All feature sets have been implemented in compliance with the TINA Ret reference point, except for the stream binding feature set which handles the negotiation and establishment of connectivity requirements. The Ret definition of this feature set was considered too complex, while the semantics of the operations and their parameters was ambiguous. VITAL proposed a new definition of the stream binding feature set, in line with the philosophy behind the other feature sets. These modifications to the Ret definition have been fed back to the TINA SARP (Service Architecture Reference Point) Work Group; most of them will be incorporated in a next update of the TINA Ret reference point specifications.

VITAL has also contributed to the definition of the “Retailer to Retailer Reference Point Specifications” which is being produced by the SARP Work Group. The VITAL input is related to federation between retailer domains in delivering a service. The VITAL retailer to retailer (RtR) reference point specification re-uses most of the interfaces of the Ret reference point and the intra-domain reference point between the access and service part of the architecture.

TINA Next Generation Mobility Work Group

The VITAL approach to discrete terminal mobility and remote user registration was presented to the TINA Next Generation Mobility Work Group. This prompted a discussion on the new terminal provider role in TINA. VITAL assessed the architectural implications of this new role and defined the necessary new subsystem and components. The description of the terminal mobility subsystem was also proposed as a means of using TINA concepts in legacy networks like ISDN.

TINA Service Management Working Group

VITAL was actively involved in the creation of the TINA Service Management Working Group in October 1997. This Work Group was set up to work on the integration of accounting, subscription, service life cycle and FCAPS management in the TINA service architecture. VITAL has participated actively, providing inputs and specifications in the areas of accounting, subscription and service life cycle management. More specifically, VITAL has provided validated IDL specifications of the subscription information model and has contributed revisions to the TINA Service Components Specification (January 1998). In this contribution VITAL has elaborated a proposal for a black-box approach to subscription computational modelling and defined the intra-domain reference point between access session and subscription management components.


OMG

The prototyping of CORBA based Intelligent Network (IN) services in VITAL has contributed to the maturing of this application of CORBA technology, currently studied within the OMG. IN is a good testing ground for introducing CORBA technology in telecommunications, especially for evaluating the performance and scalability of CORBA implementations. The work undertaken in VITAL with CORBA based IN services forms the basis for a proof of a concept, and has given rise to a group of new standards within the Object Management Group (OMG). The emphasis of the VITAL contribution was on ensuring interworking between the distributed, DPE centered TINA world, and the centralised IN world. The submissions made by IONA Technologies Ltd. to the OMG RFP are entitled telecom/97-12-06: “Interworking between CORBA and Intelligent Network Systems RFP” and telecom/98-05-06: “update of the IONA/NORTEL initial submission to the CORBA/IN RFP”. An newly revised contribution is currently in the making.

The Telecommunications task force of the OMG has issued an RFI (Request For Information) on a Notification Service in 1997. The design of the Notification Service for VITAL has strongly influenced the following RFP (Request For Proposal). The resulting OMG standard was the result of a merge of four submitted proposals, and the VITAL Notification service has been implemented in line with this.

UMTS-F

Alcatel Bell and other VITAL partners are using VITAL specifications in on-going work on UMTS specifications and implementation. At the moment, UMTS is entering in an important definition phase where solutions are sought for its service architecture. These solutions should take into account both the broad service requirements of the UMTS architecture and the legacy networks from which it evolves. TINA will almost certainly be of definitive influence on the UMTS service architecture specification. As VITAL has validated TINA concepts, the knowledge gained in the project is of great value to UMTS.
7. Impact, Exploitation and Dissemination of Results

The main output of the VITAL project is technical. The end result of the project consists of specifications, running code, deliverables, and a demonstrator. However the project has also produced results in the form of working practices, implicit design patterns and a certain working spirit among the participating partners. In the long term, these results will prove at least as important as the more ‘measurable’ project results. In the following sections we take a look at the most important spin-off that VITAL will generate in terms of specifications, code, demonstrator, design, products and socio-economic aspects.

Specifications

VITAL has implemented and validated TINA-C specifications of the Retailer and ConS reference point and Service and Network Resource Architecture component specifications. In the course of implementing VITAL has extended and refined these specifications where necessary, thus contributing to the evolution of these specifications. In practice TINA and VITAL have formed a tight feedback loop of specification, implementation and validation.

As such VITAL is probably the world’s richest source of experience in implementing TINA specifications. It is evident that this experience will be used by partners that plan to move towards open distributed networks and services. It is expected that the Retailer reference point specifications may become a de-facto standard for the interface between end-users and service providers in ‘open’ network architectures. Network operators like CSELT, Telefónica España and Portugal Telecom have shown a strong interest in specifications for such open platforms. On the other hand, telecommunications manufacturers like Alcatel are keen to comply to the Retailer specification to comply to customer’s demands. Finally, the VITAL and TINA specifications open up the traditional telecommunications interfaces to information technology sector companies like MARI Group, IONA Technologies and Strabo.

Code

In its life time VITAL has produced three subsequent prototypes: VITALv1 (end ’96), v2 (end ’97) and v3 (end ’98). Each of these prototypes has been a refinement and extension of the previous version. Although the specifications evolved quite strongly between VITALv1 and v3, much code was re-used from one prototype to the next. As VITAL is based on object oriented principles, the code is modular and relies upon inheritance. This has much improved the re-use of modules from one prototype to the next. Generally speaking, about 70% of the code developed for VITALv2 is re-used in VITALv3.

The VITAL experience has proven the great extent to which TINA implementations are re-usable. It is therefore projected that many of the modules developed in VITAL will be re-used beyond the duration of the project, even if the system as a whole may become obsolete with time. Still more important than the code however are the specifications and the design.

Demonstrator

The end result of VITAL consists of a demonstrator that is running in several sites. There is at least one ‘portable’ demonstration that can be moved to remote conferences and fairs. The ‘portable’ demonstrator is a complete running VITAL platform with three end-user terminals, four ATM switches, one Retailer and one Connectivity Provider workstation, and a PC with a Java enabled browser.

A first version of the demonstrator was publicly shown at IS&N’98 in Antwerp, in May 1998. At that time the demonstrator ran the VITALv2 software. At the time of writing of this report, the portable demonstrator is capable of running the final VITAL prototype VITALv3.

The VITAL demonstrator will continue to exist beyond the end of the project. Although it will be exploited as the property of the responsible partners, due credit will continue to be given to the VITAL project whenever the demonstration is given. The companies that have acted as trial sites - Alcatel, Portugal Telecom, CSELT, Telefónica and University College London - will continue to demonstrate the validity of the technology developed in VITAL using their local version of the demonstrator. It is expected that the VITAL demonstrator will thus survive for several years until the technology is gradually introduced into products.

Design patterns

Perhaps one of the most important results of VITAL is the experience gained in specifying and implementing a TINA based Open Distributed Telecommunications Architecture (ODTA). Neither the specifications nor the code alone are to be considered the key value of VITAL. It is in fact the experience gained in the co-operative design and its validation that has given VITAL a unique added value. In the course of its existence VITAL has produced some invaluable design patterns for building an open distributed telecommunications system.
The VITAL design experience has not been formally documented in the form of Design Patterns\(^4\). Several partners including the Prime Contractor have however expressed the intention to record the design experience gained in VITAL in a structured way. Outside the VITAL project there has also been interest in recording the design experience. The Domain 5 projects SCREEN and TOSCA are experimenting with the use of Design Patterns in the creation of services for TINA based platforms. It could well be that Design Patterns turn out to be the most persistent output from VITAL, in addition to the specifications and code.

**Future products**

VITAL has implemented and validated communications and software technology that is available today. VITAL has integrated these technologies into an open architecture for delivering a wide variety of services over heterogeneous network environments. The VITAL results are targeted to commercialisation on the mid to long term, i.e. in a time frame of two to five years. A number of VITAL partners are already using VITAL results in technology spin-off projects. In other words, they are using parts of the technology from VITAL in new releases of existing products.

An example of a spin-off product is the distributed Intelligent Networks (IN) platform built by Alcatel in 1996. The prototype was based on an existing Alcatel IN product, but also involved distributed object-oriented service logic running over CORBA compliant middleware. It used a commercially available operating system and CORBA implementation. In fact the prototype was implemented on two different commercially available hardware platforms, thus demonstrating the portability of a CORBA-based solution. The distributed IN prototype has provided Alcatel with insights into the evolution of IN towards an open distributed service architecture.

VITAL partners are planning similar spin-off projects in the following areas:

- **intelligent networks**, evolving towards an open architecture that supports inter-operation between service providers and fixed-mobile convergence,
- **adding value to Internet services**, both at application and at connectivity level,
- **management of ADSL access networks**, particularly for managing end-to-end quality of service in ADSL access to heterogeneous data networks including ATM, Frame Relay and others,
- **next generation mobile systems**, like UMTS, providing the technology for the fixed network architecture,
- **improving switching products**, by improving call models and opening the switching architecture for external service control.

**Socio-economic aspects**

The focus of VITAL has been on implementing and validating an architecture, and the main output from VITAL has been technical. The architecture was challenged in a set of trials by means of a set of tele-training applications. The application suite was chosen in such a way as to reflect a realistic use of the VITAL architecture. The core of the tele-training application suite is a high quality audio video conferencing application. A number of additional applications allow the teacher and students to exchange short messages (‘chat’), to show slide presentations, to play sound clips from a virtual ‘juke box’ to search a digital library and retrieve multimedia documents from it, and to view and modify each other’s drawings on a virtual shared ‘white board’. The VITAL tele-training application suite provides the technology for universities that want to offer virtual campuses. A number of universities like the Open University of Catalunya in Spain have already started such initiatives.

The applications in the VITAL tele-training suite can be easily adapted to suit other application fields such as tele-medicine, computer supported co-operative working (CSCW) or electronic commerce. In his keynote speech at the 10\(^{th}\) ACTS Concertation Meetings, John Harper from BT mentioned that “there is more than enough bandwidth available today; the biggest problem is to manage and apply it well”. He further argues that “people can be trained remotely, and tele-work does work”. VITAL claims to have contributed to managing the complexity of transmission technologies available, and putting it at the service of the end-user. The VITAL trials and demonstrations are the witness of this claim.

\(^4\) Design Patterns in the sense of the publication of Gamma e.a..
8. Self Assessment

The overall objective of the VITAL project was to develop, implement, demonstrate, and validate an Open Distributed Telecommunication Architecture (ODTA) for deploying, managing and using a set of heterogeneous service features, in particular multi-media, multi-party, and mobility services. The ODTA was challenged in trials by means of a Teletraining application suite that answers the requirements of real stakeholders. In these trials the ODTA was validated in terms of reusability, extendibility and scalability of the identified components. The ODTA components were implemented and tested on available distributed object oriented technology. VITAL has given feedback to related standardisation bodies, other consortia in ACTS, and TINA-C.

In the three years of its existence, three phases of VITAL have been successfully completed. In these phases three subsequent versions of the VITAL architecture, VITALv1, VITALv2 and VITALv3, has been specified, implemented and demonstrated with success.

VITALv1 has been able to show a Desktop Video Conferencing application, a Subscription Management and a Resource Configuration Management application, a monitoring tool clearly showing the internals of the architecture in a dynamic way. All these elements were integrated with the core Open Distributed Telecommunications Architecture (ODTA), which runs on top of ATM switches of different manufacturers.

VITALv2 extended the VITALv1 architecture with an integrated tele-training kernel and additional applications including Shared Whiteboard, Slide Presentation and Web-access to subscription. Moreover, VITALv2 was demonstrated over an international ATM network of four interconnected National Host sites (Belgium, Italy, Portugal, Spain).

VITALv3 added to this an implementation of the Retailer-to-Retailer federation interface, allowing services to be delivered across service provider domains. VITALv3 also demonstrated that the ODTA can interwork with Internet, ADSL access networks, IN and TMN systems. An extensive collection of new tele-training services were implemented for VITALv3. Some of these new services can be downloaded from simple Personal Computer with a Java enabled web-browser, showing the possibility to access ODTA services from simple Internet based terminals.

The successful implementation and demonstration of VITAL specifications, the development of a broad range of applications and the contributions to the TINA-C specifications have all been realised within three incremental 12 month periods. This has only been possible because of the strong and sustained commitment of each of the partners “to make it happen”.

Progress towards the objectives of the project

VITAL has realised both tangible objectives - the trials - and non-tangible objectives - being a significant voice in the TINA community. The competence of the partners proved to be complementary, and covered the required expertise to realise the objectives of the project. Sufficient know-how was available to converge quickly to a consistent overall ODTA architecture, and to develop applications to challenge the architecture. The VITAL consortium not only fulfilled its goals successfully, it also gained the necessary authority for defending its ideas to other fora and standardisation bodies.

Contributions to the overall objectives of the Programme

VITAL was a member of the Domain 5 on Service Engineering, Security and Communications Management, and chaired the Cluster on Service Engineering and Mobility. In addition, VITAL significantly contributed in the SIA Chain on Service Architecture by contributing to Guidelines. VITAL played a leading role in the organisation of both the IS&N’98 and IS&N’99 conferences.

Deviations from plan/lessons learned

No deviations from the plan are reported. All deliverables have been delivered, and all milestones have been met on time. The project has ended on 31 October 1998 as planned.

The incremental approach taken to realising the prototype in three steps (VITALv1-v2-v3) has been very effective. VITAL recommends similar projects to also follow such an iterative development process.
### Annex I: List of Deliverables

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<tr>
<th>Deliv. Code</th>
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Annex II: List of Published Papers


J. Huélamo and D. Gómez, Discrete Terminal Mobility and Remote User Registration in TINA, TINA’99 Conference, Oahu, Hawaii, USA, April ‘99. (Submitted)


P. Lago, TINA Service Session Control supporting complex Negotiation, in Proc. of the 1st IEEE Conference on Open Architectures and Network Programming (OpenArch’98), San Francisco, (CA, USA), April 1998.

K. Myksvoll, H.A. Berg, and S. Brennan, An Interworking Function between CORBA and Intelligent Network Systems and a framework to facilitate rapid development of CORBA based IN services, Softcom ’98.

G. Pavlou e.a., Implementing TMN-like Management Services in TINA: a Case Study in Resource Configuration Management, JNSM special issue on TINA, submitted.


G. Pavlou, A Critical Overview of TINA and its Relationship to IN, TMN, Signalling and the Internet, IS&N’98


P. Rocha, R. Machado, P. Loureiro, T. Mota, *Deployment of Services based on TINA Architecture*, submitted to the ConfTele99, Sesimbra (Portugal), April 1999


### Annex III: List of Patents

<table>
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<td>Un Sistema de Red de Comunicaciones con Movilidad de Terminal Discreta y Registro de Usuario Remoto asociado a dicha Movilidad</td>
<td>Spain</td>
<td>June 12, 1998</td>
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