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## **Deliverable D1.1**

### **Annual Report (February 1996 - January 1997)**

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#### **Abstract:**

*This Deliverable presents the Annual Report for the first year of the project. It summarises the objectives of the project and describes the work undertaken to achieve the objectives. It highlights the main achievements and the major difficulties encountered during the period. It includes abstracts of the deliverables submitted and details the promotional activities undertaken, along with references to information material available regarding the project. It indicates the changes foreseen to the current project plan in the coming year.*

#### **Keywords:**

Annual Report

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## Part I: Executive Summary

The keywords for TEN-34 in its first year were: 'slow but steady progress'. Slow, because of the many parties, interests, and perspectives involved; progress because of the significant achievements made on a European scale. The activities undertaken during this year fall into three main categories: commercial planning and negotiations, technical issues regarding deployment of the network, and ATM testing activities.

Work carried out with respect to commercial matters addressed issues both within the consortium and with suppliers. Internal issues concern the establishment of a cost allocation model and of an agreement regarding procedures for the distribution of the EU funding, the finalisation of a Consortium Agreement among the partners based on these principles, and the inclusion of a number of additional organisations, among them international user organisations, as Associated Contractors in the EC Contract. Significant effort was spent on agreeing a network configuration which would satisfy to the greatest extent possible the requirements of the NRNs while remaining within the budget available. A limited call for tender was conducted within the consortium to award a contract for the Network Operation Service. With respect to suppliers, the first step was to ascertain from the individual telecoms operators what they were willing and able to provide, and at what prices, that could be used to build a pan-European network service. From the offers available, some of which took much effort to obtain, and after extensive negotiations with the individual suppliers to reduce prices to an affordable level, a configuration for the TEN-34 network was agreed. Fifteen separate contracts between NRNs and telecom operators are required for the provision of the transmission components of the planned network; extensive contract negotiations have been conducted with respect to 10 of these. The others concern NRNs with connections scheduled beyond the first quarter of Year 2 of the project. Work on facilities management contracts and maintenance contracts for the TEN-34 routers was also carried out.

The Technical Group, established with representatives of all the partners, contributed to the decision making process with respect to the TEN-34 configuration, which consists of two subnetworks: the first, a managed IP service linking six countries which is provided by Unisource, and the other, a set of ATM VP half circuits or leased half circuits used to build the rest of the network. Once the configuration was agreed, including the interconnections between the two subnetworks, the Technical Group developed a detailed implementation plan, an acceptance test plan and a routing plan. The requirements for a Network Management Service were defined, and were used as the basis of the limited call for tender within the consortium for the Network Operations Service, which handles the day-to-day operation of the network.

TEN-34 organised a Task Force TEN (TF-TEN) under the auspices of the Lower-Layer Technology Working Group of TERENA (Trans-European Research and Education Networking Association) to carry out the ATM testing activities included in the project plan. The TEN-34 NRNs are active members of this task force which is chaired by a staff member of the TEN-34 Co-ordinator, DANTE. TF-TEN specified a test programme for the first phase of testing consisting of ten experiments. These experiments address essential new technologies such as signalling, VBR services, and IP routing over ATM. In high-speed tests the performance of IP over ATM and native ATM performance are examined. Participants in the tests are all the NRNs of the TEN-34 project. Work on the experiments of this first phase was carried out and an interim report of the results was produced. To avoid any disruption to the operational service, the tests of the advanced ATM services are carried out over the JAMES ATM network, which is physically separate from the TEN-34 production IP network, and intended for such experimental usage. There have been extensive discussions with JAMES to set up the required test infrastructure. The facilities provided by JAMES for use by TF-TEN consist of a fixed set of VPs which are used as a virtual private network within the JAMES infrastructure. There has been very little participation from JAMES in the task force activities, and only in 2 of the 11 experiments.

A variety of promotional activities have been undertaken to raise awareness and visibility of the TEN-34 Project - through the World Wide Web, via dissemination of printed materials, via press releases, by giving presentations at conferences, participating in industry exhibitions, and through participation in EC organised events. As a result of this activity TEN-34 currently offers a combination of electronic and paper documentation, mechanisms for regular updates on activities and progress in TEN-34, as well as a pan-European network of information dissemination through the partners in the Consortium: the 14 National Research Networks involved.

The major achievements of the project during its first year are:

- obtaining firm offers from most of the PNOs for services which can be used to create the TEN-34 network;
- agreement by the partners on a TEN-34 configuration which represents a compromise that best satisfies the partners' requirements within the constraints of available offers and budget;
- agreement on a cost allocation model whereby total shared network costs are distributed according to the access capacity subscribed and the type of connection, resulting in an allocated network cost independent of the direct costs incurred by an NRN via its contracts with suppliers for service provision;
- agreement on a funding distribution model whereby the NRN partners are each funded for the same percentage of their allocated network cost;
- submission of the milestone M1 deliverables documenting the commercial and technical plans of the project developed during the specification phase;
- signature of a consortium agreement based on the principles documented in the M1 deliverables;
- organisation of a limited call for tender within the consortium for the provision of the Network Operations Service, and award of the relevant contract;
- submission of a revised technical annex, to be included in a contract amendment, based on the solution proposed in the M1 deliverables and taking account of the Project Officer's comments;
- conclusion and signature of a contract with Unisource for provision of a managed IP service to six access ports;
- preparation and submission of an interim report on the results of the ATM testing activities.

The project encountered difficulties in a number of areas, in particular with respect to:

- obtaining offers of service from the telecom operators at affordable cost,
- concluding contracts with the operators,
- finding firm and affordable solutions for connecting Portugal and Belgium,
- concluding a collaboration agreement with JAMES, and with
- the limited scope of services offered by JAMES.

The original project plan was modified as a result of the specification phase of the project, and the changes were documented in the Milestone M1 deliverables, and are incorporated in the revised technical annex for the proposed contract amendment. The only significant change to that plan foreseen in the second year of the project, other than possible delays in actual deployment dates which may arise, are the inclusion of additional NRNs in a future contract amendment. Plans are being made to include both the Czech and Slovenian NRNs (CESnet and ARNES respectively) in TEN-34.

Delays in the deployment of the network, from the original plan of February 1996, taken in conjunction with the interim results of the ATM testing conducted in WP11, tend to indicate that the scope for transferring more advanced ATM services to the operational network, as foreseen in WP12, may be very limited.

## **Part II: Summary of Work Undertaken**

### **1. Objectives of the Project**

The objective of the TEN-34 project is to deploy trans-European networking facilities which will provide complementary international capacity to allow the national research network investments to be exploited on a global basis and maintain the competitiveness of European research. The technical implementation of the high speed network for research addresses the dual requirements of providing greater capacity and supporting the emerging multi-media applications.

A two part approach to implementation has been adopted consisting of:

- The immediate introduction of a high speed international service based on 4 - 45 Mbps access using a combination of ATM Virtual Path based interconnect, a managed IP service and leased circuits and the existing Internet Protocol (IP) to those countries which can already exploit a service at this speed, with expansion to other countries as they become ready. The ATM based service will at first support only existing IP based services, but will evolve to exploit directly the advanced features that ATM can offer. It is expected that these features will migrate progressively via a pilot service to a production service over a four year period.
- In view of the immaturity of ATM technology, an ATM test bed is being used to validate new developments and features in advance of their introduction in pilot services. Collaboration with the JAMES project has been agreed to use their experimental ATM network for this purpose.

### **2. Work Done**

During the first year of the project (February 1996 to January 1997 inclusive) slow but steady progress has been made towards achieving the objective. The activities undertaken fall into three main categories:

- commercial planning and negotiations,
- technical issues regarding deployment of the network,
- ATM testing activities.

In addition to activities in these main areas, the TEN-34 Project Manager and a number of the NRNs have participated in events to publicise the project and the TEN-34 network service.

Discussions have been held with representatives of the international user groups who have agreed to evaluate the new service. The participation of the user groups in the project is of particular importance as it will enable the performance of the network to be objectively assessed by a groups of users for whom international connectivity is especially important.

#### **2.1. Commercial Planning and Negotiations**

Work carried out with respect to commercial matters addressed issues both within the consortium and with suppliers.

Internal issues concern the establishment of a cost allocation model and of an agreement regarding procedures for the distribution of the EU funding, the finalisation of a Consortium Agreement among the partners based on these principles, and the inclusion of a number of additional organisations as Associated Contractors in the EC Contract. A great deal of effort was also spent on agreeing a network configuration which would satisfy to the greatest extent possible the requirements of the NRNs while remaining within the budget available. A limited call for tender was conducted within the consortium to award a contract for the Network Operation Service.

With respect to suppliers, the first step was to ascertain from the individual telecoms operators what they were willing and able to provide, and at what prices, that could be used to build a pan-European network service. The individual NRNs approached their national telecom operators with requests to participate in the TEN-34 project. From the offers available, some of which took much effort to obtain, and after extensive negotiations with the individual suppliers to reduce prices to an affordable level, a configuration for the TEN-34 network was agreed.

Fifteen separate contracts between NRNs and telecom operators are required for the provision of the transmission components of the planned network; extensive contract negotiations have been conducted with respect to 10 of these. The others concern NRNs with connections scheduled beyond the first quarter of Year 2 of the project. Work on facilities management contracts and maintenance contracts for the TEN-34 routers was also carried out.

Contract negotiations were concluded with one of the user organisations which will evaluate the service regarding their participation in the project as associated contractors.

## **2.2. Technical Issues regarding Deployment**

A Technical Group was established with representatives of all the partners. This group contributed to the decision making process with respect to the TEN-34 configuration, which consists of two subnetworks:

- the first, a managed IP service linking six countries which is provided by Unisource, and
- the other, a set of ATM VP half circuits or leased half circuits used to build the rest of the network.

Once the configuration was agreed, including the interconnections between the two subnetworks, the Technical Group developed a detailed implementation plan, an acceptance test plan and a routing plan. The requirements for a Network Management Service were defined, and were used as the basis of the limited call for tender within the consortium for the Network Operations Service, which handles the day-to-day operation of the network.

Members of the Technical Group, led by DANTE, participated in the contract negotiations regarding the technical issues, in particular the definition of the parameters of service for ATM half links, both in terms of providing satisfactory performance and ensuring technical consistency of the half circuits, and of the acceptance test procedures to be followed. They also contributed to the definition of the technical parameters of the Unisource managed IP service and of the acceptance test procedures for that service.

## **2.3. ATM Testing Activities**

To carry out this part of the work plan, TEN-34 organised a Task Force TEN (TF-TEN) under the auspices of the Lower-Layer Technology Working Group of TERENA (Trans-European Research and Education Networking Association). The TEN-34 NRNs are active members of this task force which is chaired by a staff member of the TEN-34 Co-ordinator, DANTE.

TF-TEN specified a test programme for the first phase of testing consisting of ten experiments. These experiments address essential new technologies such as signalling, VBR services, and IP routing over ATM. In high-speed tests the performance of IP over ATM and native ATM performance are examined. Participants in the tests are all the NRNs of the TEN-34 project. Work on the experiments of this first phase was carried out and an interim report of the results was produced.

Since it is essential that tests of advanced services are carried out on an infrastructure separate from the service network, to avoid any disruption of service, the tests of the advanced ATM services are carried out over the JAMES ATM network, which is physically separate from the TEN-34 production IP network, and intended for such experimental usage. There have been extensive discussions with JAMES to set up the required test infrastructure. The facilities provided by JAMES for use by TF-TEN consist of a fixed set of VPs which are used as a virtual private network within the JAMES infrastructure.

There has been very little participation from JAMES in the task force activities, and only in 2 of the 11 experiments.

## **3. Achievements**

Significant progress was achieved with respect to the project objectives. The major achievements are listed below.

### **1. PNO Offers**

Offers for connection of all the NRNs were obtained from the telecom operators; some were for ATM half circuits, others for leased line service, and another for a managed IP service. With two exceptions, these materialised into firm offers which were incorporated into the financial figures presented in Deliverable D3.1 in August 1996.

## 2. TEN-34 Configuration

Based on the offers available, the connectivity requirements of the partners, and the available budget, a TEN-34 network configuration was agreed among the partners. The network is composed of two distinct subnetworks. One of these is an IP subnetwork with nodes in six<sup>1</sup> countries, provided by Unisource Business Networks. The other is composed of individual lines and ATM VP components, collectively known as FUDI<sup>2</sup>, provided by nine national telecom operators, with nodes in six countries and serving nine countries. The IP service over this transport infrastructure is provided by the TEN-34 NRNs. The interconnection of the two subnetworks is made at the nodes in three countries. In addition three 34 Mbps lines between Sweden and Denmark, Norway and Finland ensure high speed connections within NORDUnet. It was recognised that the configuration was less than ideal, but it represents a compromise that best satisfies the partners' requirements within the constraints of available offers and budget. The NRNs agreed to subscribe to access capacities ranging from 4 Mbps to 45 Mbps.

## 3. Cost Allocation Model

The partners agreed on a cost allocation model in which the total cost of the network, with the exception of the internal Nordic lines, is distributed among the participants according to the access capacity subscribed by each and the type of connection - whether on a spur (sensitive to failure of the single trunk line to the rest of the network) or connected to a node with two or more trunk lines. Individual NRNs are expected to contract with their respective telecoms operators for parts of the service, and to pay invoices issued by the operators. A clearing house function operated by DANTE will reconcile direct costs against allocated costs, and issue invoices or credits to individual NRNs as appropriate, such that the net cost to each NRN is its Allocated Network Cost.

## 4. Distribution of EC Funding

The distribution of the EC funding was agreed among the partners. While cost statements will be submitted and EC funding will be based on the direct costs sustained by each partner, the partners have agreed that the EC contribution will be put into a common pool, and that it will be allocated to the partners as the same percentage for each funded partner of its Allocated Network Cost. This distribution will be accomplished through the clearing house function. The exceptions to this rule are with respect to the internal Nordic lines, for which the EC contribution will be passed directly to NORDUnet, and to the Associated Contractors who will also receive the EC contribution to their costs as specified by the contract.

## 5. Milestone M1

The Milestone M1 deliverables were submitted at the end of August 1996. These documented the commercial agreements among the partners, the offers from the telecoms operators, the detailed network deployment plan, the network management service requirements, and the acceptance test plans, and the changed composition of the project participants, including additional Contractors, Associated Contractors and Subcontractors.

## 6. Consortium Agreement

A Consortium Agreement was agreed and signed by all the partners. The agreement incorporates all the principles documented in the Milestone M1 deliverables, and defines the mechanisms for the operation of the consortium and for any future expansion. Following the signature of the agreement the Management Committee defined by the agreement was constituted as a replacement of the Steering Group that had operated since before the EC Contract was signed. A Chairman and Technical and Financial Officers were appointed by the Management Committee as required by the Consortium Agreement.

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<sup>1</sup> At the time the M1 deliverables were submitted it was expected that there would be nodes in seven countries, but no formal agreement has yet been reached regarding Belgium.

<sup>2</sup> This acronym is historical as this part of TEN-34 started out as an offering from the four operators from France (F), UK (U), Germany (D), and Italy (I).

#### 7. NOS Contract Awarded

A Call for Tender was organised within the consortium for the provision of the Network Operations Service, responsible for the day-to-day operation of the network under the management of DANTE. Five proposals were received; two of which were rejected, and the others submitted for further evaluation. Based on the recommendations of the evaluators, and with the agreement of the Management Committee, a contract was awarded to UKERNA.

#### 8. Revised Technical Annex for Contract Amendment

Following approval of Milestone M1, a revised technical annex was prepared taking into account the solution proposed in the M1 deliverables and the Project Officer's comments.

#### 9. Unisource Contract

After long negotiations a contract was agreed with Unisource Business Networks Belgium for the provision of a managed IP service to six access ports, and was signed by four NRNs and Unisource in December 1996. Three of the access ports are also in the same locations as nodes in the FUDI part of the network, and the interconnection of the two subnetworks is thus achieved.

#### 10. Interim Report on ATM Testing

An interim report on the results of the ATM experiments was produced. It shows that basic ATM services such as CBR are well understood and can be used in a production environment. In the area of the more advanced ATM services the interim results demonstrate that the services vary from being usable only under very idealistic circumstances (e.g., switching), to potentially providing a stable infrastructure, pending further investigation (e.g., VBR).

### 4. Deliverables

The list below reflects the deliverables which were submitted during this period, along with the abstract of the deliverable as submitted:

#### Deliverable No.    Title and Abstract

D2.1

##### ***Project Information Materials***

This deliverable addresses the preparation and dissemination of information material on TEN-34 during the first ten months of the project. The information material describes the project's objectives, activities and results.

D3.1

##### ***Report on Initial Commercial Model***

This deliverable documents the commercial model that the partners in the TEN-34 Project have adopted. It defines the costs for the full 30 month project broken down by category and into two 15 month periods, the first of which corresponds to the current contractual period. It also defines which costs will be incurred by each partner.

Based on these costs, and in order to equitably distribute the network costs among the participating NRNs, irrespective of the partner which actually incurred them, a cost allocation model has been developed which defines an annual subscription cost for different access capacities, which vary from 4 Mb to 45 Mb at the outset. The only variation in charge for a given access capacity is a 10% reduction for NRNs on spur connections. The distribution of the EU contribution among the partners has been agreed; each subscribing NRN will receive the same percentage of its allocated cost as an EU contribution.

Procedures for the distribution of the EU contributions and the collection of allocated costs have been agreed which minimise the international flow of funds. The VAT implications of the various financial transactions are reviewed, as well as the status of the various contracts and agreements required in support of the EC contract.

The consortium has agreed that the commercial model may be reviewed periodically, as required.

## D4.1

***Detailed Network deployment Plan***

This deliverable documents the TEN-34 Network Deployment Plan. It details the structure of the network which is composed of two distinct subnetworks. One of these is an IP subnetwork with nodes in seven<sup>3</sup> countries, provided by Unisource Business Networks. The other is composed of individual lines and ATM VP components provided by nine national telecom operators, with nodes in six countries and serving nine countries. The IP service over this transport infrastructure is provided by the TEN-34 Contractors (the NRNs). The interconnection of the two subnetworks is made between nodes in three countries.

The planned implementation schedule is provided, as well as the initial IP routing plan to support the planned configuration.

## D4.2

***Acceptance Test Plan***

Before declaring the TEN-34 network operational, the TEN-34 consortium will conduct an acceptance test on the network. This acceptance test aims to verify the ability of the TEN-34 network to transmit IP packets over the network with an appropriate performance. The acceptance test is divided into three main phases. First the two subnetworks, the Unisource network and the FUDI network will be tested separately, then in a third phase the interworking of the two subnetworks will be tested. A set of testing procedures and acceptance criteria for each of these three tests has been defined. These tests will be carried out primarily on the IP level, and on the ATM level where applicable. All tests will be carried out under ideal circumstances, usually on an unloaded network.

The TEN-34 network will be considered to have passed the acceptance test if all test programs for the three sub-tests are completed successfully.

## D7.1

***Requirements Specification for Network Management Service (NMS)***

This deliverable documents the requirements for a Network Management Service for the TEN-34 Network Service. The NMS will integrate the two TEN-34 subnetworks and provide a single integrated service for the entire TEN-34 community. The TEN-34 networking entities are not all under direct control of the TEN-34 Contractors, nor are they under direct control of a single body. For the set-up of an efficient NMS it is necessary that a single overall Network Management Co-ordinating Entity (NMCE) be defined.

## D11.1

***Specification of Phase 1 Test Programme***

This deliverable specifies the experiments that will be carried out in the TEN-34 Phase 1 Test Programme over the JAMES ATM network, which is physically separate from the TEN-34 production IP network. These tests of advanced services are carried out on an infrastructure separate from the operational services to avoid any negative impact on production traffic and to acquire operational expertise before any new service can be offered in a production environment.

The main emphasis in this phase lies in examining the underlying technology for its suitability to support advanced applications. A major part of the work is expected to be in the area of fine-tuning the systems to maximise the performance, and to understand the full implications of different traffic parameters. Most of the tests in Phase 1 of the test programme concentrate on the advanced provisioning of IP services, which will still be required for most applications of the NRNs.

## D11.2

***Interim Results of Phase 1 Test Programme***

In Deliverable D11.1 a set of ATM experiments was specified as part of the TEN-34 Phase 1 Test Programme over the JAMES ATM network. This deliverable describes the interim results of these experiments.

The main emphasis in this phase lies in examining the underlying technology for its suitability to support advanced applications. Some of the experiments concentrate on fine-tuning systems to maximise performance; others investigate the usability of new

<sup>3</sup> At the time this deliverables were submitted it was expected that there would be nodes in seven countries, but no formal agreement has yet been reached regarding Belgium.

technologies and ATM traffic classes.

The interim results of the experiments have shown that basic ATM services such as CBR are well understood and can be used in a production environment. In the area of the more advanced ATM services the interim results demonstrate that the services vary from being usable only under very idealistic circumstances (e.g., switching), to potentially providing a stable infrastructure, pending further investigation (e.g., VBR).

The most important result of the experiments so far is that switching proves to be very difficult to use in the way it was created for, which is between end-user applications. There are no major problems with switching in a LAN environment, where bandwidth is close to unlimited. But over a public wide area network, with significant bottlenecks and policing, SVCs can only be used under severe limitations. Due to the number of diverse problems it is not expected to have SVCs available in a general production environment within the next two to three years.

## 5. Difficulties Encountered

The project encountered difficulties in a number of areas, in particular with respect to:

- obtaining offers of service from the telecom operators at affordable cost,
- concluding contracts with the operators,
- finding firm and affordable solutions for connecting Portugal and Belgium,
- concluding a collaboration agreement with JAMES, and with
- the limited scope of services offered by JAMES.

### 5.1. Telecom Operator Offers

Originally the TEN-34 partners approached their respective telecom operators with a view to obtaining 34 Mbps leased lines with which to build the TEN-34 network. It soon became obvious that most operators were reluctant to provide such services, either in that they simply would not quote for a 34 Mbps leased line or, if they did, the prices were nearly linear with respect to 2 Mbps. The only leased lines incorporated in TEN-34 are in fact the internal Nordic lines and one line between Germany and Switzerland. The target price of 4 times 2 Mbps prices for 34 Mbps lines also proved to be unrealistically optimistic.

Rather than leased lines, Unisource offered a managed IP service in their home countries (Netherlands, Spain, Sweden and Switzerland) and in Germany and the UK. The price quoted for 34 Mbps connections between the countries was excessive, and eventually a solution was found by reducing the connections to 22 Mbps to achieve an affordable cost, taking into account the EU funding.

The major operators in France, UK, Germany and Italy joined together in discussions to offer ATM VP services, but the original pricing, which varied by operator, was generally prohibitive. There were also technical concerns about the service offered. In fact it was not a cohesive managed service, but rather a set of bilateral arrangements between the operators presented as a single solution. After lengthy discussions, and with pressure from the Commission, the NRNs obtained prices for 6 to 24 Mbps services which were affordable taking into account the EU funding, and an acceptable technical solution. The Swiss, Greek, Austrian and Hungarian operators also agreed to offer ATM VP services.

The network configuration eventually agreed among the partners was less than ideal, and includes individual NRN accesses ranging from 4 to 45 Mbps. It reflects a compromise between requirements and budgetary constraints. The process to arrive at an agreed configuration based on firm offers took more than a year to achieve, for a service which will run for 17 months, and which does not yet include a definitive solution for Belgium and Portugal.

### 5.2. Contract Negotiations

Contract negotiations with the operators proved to be very difficult and lengthy.

Negotiations with Unisource took nearly six months to conclude. Difficulties arose with regard to a number of issues, the most significant of which were:

1. difficulty in agreeing the parameters of service, in particular the configuration to support 22 Mbps access at the six NRN access sites within the price offer already accepted;
2. agreement regarding the parameters and parameter values that would be used in the acceptance testing;
3. agreeing the two conditions under which the NRNs would not be obliged to continue with the service under the existing contractual terms until the contract termination date of 31 July 1998, i.e. if the EC terminates the project, or does not extend the contract to the expected full 30 month duration, and should a regulatory body force a price increase;
4. agreement on what, if any, service guarantees would be provided;
5. difficulties regarding the contract structure, and the number of specific conditions that the NRNs wished to include, ensuring that the terms of the standard Unisource General Conditions which form an integral part of the contract, were overridden as required; and
6. determining who the signatories to the contract should be, and the share of the contract value to be borne by each.

With respect to the FUDI operators, there was the basic problem that there were a significant number of contracts required, one with each of the operators supplying a part of the overall TEN-34 configuration. That in itself makes the process repetitive and lengthy from the project management point of view. Nonetheless there were a few issues which were common to all the negotiations.

1. The individual PNOs (and their legal departments) produced the contract text; the incorporation of NRN comments in revised drafts was a slow process, and did not always produce the anticipated results, giving rise to yet another revision.
2. The fact that the contract either had to be drafted in English, or a certified English translation made available, made the process slower. This was required to ensure universal understanding by all the Management Committee members, who must approve the proposed contract before it can be accepted.
3. There was great difficulty in agreeing with the operators an acceptance test procedure. The operators insisted that they were providing only an ATM service, while the NRNs have always insisted that any transmission service must adequately support the IP service for which it will be used. This incompatibility of objectives was not resolved at the end of the first year of the project and threatened to delay the deployment.
4. A surprisingly large amount of effort had to be devoted to ensuring that the two telecom operators providing each half of a single ATM VP agreed on common parameters values (e.g. cell transmission rates) for the two ends of a single circuit.

In addition, discussions with OTE for the provision of service in Greece have proceeded slowly as a result of difficulties in reaching a bilateral agreement between the telecom operators, OTE and Telecom Italia.

### **5.3. Solutions for Belgium and Portugal**

Although TEN-34 was given preliminary prices for connections from Belgium and Portugal, firm offers based on operator commitments have not yet been obtained. The preliminary pricing has been included in the cost data of the proposed contract amendment.

In the case of Portugal, although Portugal Telecom had previously appeared eager to participate in TEN-34 and had provided pricing for a connection to Spain, they subsequently indicated that they did not have a circuit available over which to provide a connection to another country. The possibility of using a satellite connection is being investigated.

Belgacom, the Belgian national operator, has never indicated any interest in participating in TEN-34; their pricing has continued to be prohibitive. Although a solution involving connection of BELNET to the Unisource managed IP subnetwork was foreseen, a cost effective means of connecting from the Unisource Amsterdam node to Belgium has not yet been found. BELNET is investigating use of a cable based service to provide cross border connectivity between BELNET and SURFnet nodes near their common border.

#### 5.4. JAMES Collaboration Agreement

TEN-34 has experienced difficulties in concluding the collaboration agreement with JAMES for access to the JAMES infrastructure, and for the joint collaboration. While this has not impeded ad hoc use of the JAMES services, concrete plans for the joint collaboration are not yet finalised. Little if any progress was made on defining the roles of the two projects in any joint experiments. For a lengthy period it was difficult even to arrange meetings with JAMES to progress the issue. A proposed agreement presented by JAMES was found to be unacceptable as the bulk of the agreement dealt with IPR matters, and not at all with agreements on service characteristics or collaboration on joint experiments. JAMES technical representatives participated in a TF-TEN meeting at the end of October 1996, and significant progress was made in better understanding the mutual interests and possibilities. Detailed plans for the joint experiments are being defined between the experiment leaders on both sides. Following a constructive meeting in December, during a follow-up discussion in January on progress on a revised text, JAMES indicated that they had not been able to produce a revision and took up DANTE's offer to prepare the revised draft. DANTE undertook to produce the draft in February 1997.

The operational procedures for the JAMES network are very basic. There is only one contact person per PNO with no backup specified in case the main contact is not available. There are no service level arrangements such as set-up time for VPs, so that it is not clear how much lead time is required for VP delivery. These problems have made the planning of an international set of experiments difficult. Nonetheless, it must be said that the JAMES staff have always been helpful and tried to fulfil the TF-TEN requirements for fixed VPs to the best of their capabilities.

#### 5.5. Limited Scope of JAMES Services

JAMES only supports very basic ATM traffic classes. As of the end of 1996 only CBR, leased line emulation, SMDS and an IP service were supported. The only relevant service to TEN-34 in this context is CBR; the IP service is not of interest to TEN-34 for testing purposes, as TEN-34 is interested in the implementation details of IP over ATM, not just in using an IP service. Only limited VBR services and no switching have been made available during 1996. It is expected that switching services will be available by the middle of 1997.

The lack of switching has to some extent been circumvented by TEN-34 by tunnelling the switching information through an overlay network of CBR VPs. TEN-34 requested a large static set of VPs for a period of several months, so that the bandwidth could be allocated to experiments directly by TEN-34, rather than going through the JAMES procedures in each case. Thus an overlay network was constructed. JAMES has been used only as a transmission infrastructure, with all switching being done in the ATM switches of the NRNs. In this way TEN-34 was able to set up an SVC network despite the fact that JAMES does not support switching directly. The results of these tests are valid nevertheless for the type of equipment used, but it would be desirable to be able to verify the results over a fully switched infrastructure with a diverse range of switches. Moreover, this arrangement only provides a sub-set of configurations to be tested and does not provide all the information needed to implement SVC services on the TEN-34 production network, as the network itself must support switching as well to make full use of the new capability.

VBR service has been available only between certain JAMES nodes, and in most countries is not offered by the national operators, thus in most cases an end-to-end service is not available. A service between Germany and the Netherlands became available, but given TEN-34 resource constraints in those countries, was not able to be used during phase 1 of the ATM testing. This limited scope could not be circumvented by TEN-34, so that the planned VBR experiment has been delayed.

### 6. Project Promotional Activities

A variety of activities have been undertaken to raise awareness and visibility of the TEN-34 Project. These include:

- maintaining TEN-34 World Wide Web pages on the DANTE web server,
- production of a full colour brochure and map and other leaflets describing the TEN-34 network and Project,
- presentations at conferences and events,
- the publication of papers presented,
- presence at industry exhibitions,
- dissemination of press releases and other publications, and

- participation in EC organised events.

As a result of this activity TEN-34 currently offers a combination of electronic and paper documentation, mechanisms for regular updates on activities and progress in TEN-34, as well as a pan-European network of information dissemination through the partners in the Consortium: the 14 National Research Networks involved.

Details of the main promotional and information materials are shown in Annex 1.

## **7. Changes to the Project Plan**

The original project plan was modified as a result of the specification phase of the project, and the changes were documented in the Milestone M1 deliverables, and are incorporated in the revised technical annex for the proposed contract amendment.

The only significant change to that plan foreseen in the second year of the project, other than possible delays in actual deployment dates which may arise, are the inclusion of additional NRNs in a future contract amendment. Plans are being made to include both the Czech and Slovenian NRNs (CESnet and ARNES respectively) in TEN-34.

Delays in the deployment of the network, from the original plan of February 1996, taken in conjunction with the interim results of the ATM testing conducted in WP11, tend to indicate that the scope for transferring more advanced ATM services to the operational network, as foreseen in WP12, may be very limited.

## Annex 1

### Promotional and Information Materials

#### **Brochures/leaflets:**

- TEN-34 - The Information Superhighway for European Researchers, 4 pages A-4, A-2 size map on the back, September 1996.
- The TEN-34 Network, two page A-4 leaflet describing the implementation of the network, November 1996.
- TEN-34 TF-TEN: Testing of Advanced ATM Technology, one page A-4 leaflet listing the planned ATM tests as part of the TEN-34 Project, November 1996.

#### **Press releases:**

- TEN-34 Consortium: towards a real Superhighway for European Research, 16 May 1995
- EC Contract for TEN-34 Breakthrough in European Networking, 17 May 1996

#### **URLs of web pages:**

- TEN-34 home page: <http://www.dante.net/ten-34>
- TF-TEN home page: <http://www.dante.net/ten-34/tf-ten>
- TEN-34 publications: <http://www.dante.net/ten-34/pp.html>
- MORE ON TEN-34: <http://www.dante.net/ten-34/mot-34.html>
- The Works of DANTE: <http://www.dante.net/pubs/works.html>
- DANTE IN PRINT: <http://www.dante.net/pubs/dip.html>
- DANTE Annual Reports: <http://www.dante.net/pubs/ar.html>

#### **Papers and presentations on TEN-34**

- **TEN-34: Ein Breitbandnetz für Europäische Forschung**, Dai Davies, CeBIT, Hannover, March 1996
- **TEN-34: A 34 Mbit/s Infrastructure for European Research\*** Dai Davies, ATM Europe 96, a conference organised by ATM Perspectives, 19-21 March 1996 in Paris
- **TEN-34, Progress on High Speed Networking in Europe**, Howard Davies, 7th Joint European Networking Conference, 13-16 May 1996 in Budapest, Hungary
- **TEN-34 and JAMES: Technical Plans\***, Michael Behringer, Prepared (not selected for presentation) for 7th Joint European Networking Conference, 13-16 May 1996 in Budapest, Hungary
- **TEN-34 - Progress on High Speed Networking in Europe**, Dai Davies, June 1996, ESnet Conference, Elba
- **ATM and the Internet - A Service Provider Perspective\***, Michael Behringer, ATM - Developing the Broadband Future 1996 Conference, 2-4 July 1996, Paris.
- **Trans-European Network Interconnect at 34 Mbps**, David Hartley, Meeting of the European Networking Policy Group, Stockholm, September 1996
- **TEN-34 and DANTE**, Maria Pallares, INFN Network Workshop, 14 October 1996, Catania, Italy
- **The Challenges of building the pan-European Optoroute for Research\***, Dai Davies, Optoroute'96, Grenoble, 16 October 1996
- **Building the pan-European information superhighway for research**, Dai Davies, Asia-Pacific Advanced Network (APAN) Workshop, Tokyo, Japan, 8 November 1996
- **Broadband Telematics Infrastructure**, David Hartley, First Annual Concertation Meeting of the Telematics Application Programme, 2-3 December 1996

\* The titles marked with an asterix have been published in the WORKS of DANTE.