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Project Information Material

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Abstract:

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.

Keywords:

information provision, web site, presentations, papers, exhibitions, workshops

Table of Contents

Executive summary

This deliverable describes the information materials that have been prepared and disseminated to raise awareness and visibility of TEN-34. The Information Material describes TEN-34's objectives, activities and results during the first ten months of the project. The aim of this activity is to provide a complete package of information about TEN-34 tailored to the needs of the individual target groups using all appropriate and available means and channels.

Information material for the following target groups was produced and disseminated: the partners in the TEN-34 Consortium: the European national research networks (NRNs), both at a management and a technical level, the prospective users of TEN-34: researchers connected to the NRNs, the press, the general public, related projects and initiatives in Europe, European organisations with an interest in TEN-34, and organisations/initiatives with a similar interest in other continents.

The following categories of information materials were produced and disseminated: World Wide Web pages on the DANTE web server, 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 exhibitions, press releases, 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 16 European (National) Research Networks involved.

1. Introduction

Since the start of the TEN-34 project in February 1996 TEN-34 has organised information provision about the project in a number of ways and for a number of audiences. DANTE, as coordinating partner in the TEN-34 Consortium, uses its facilities and acts as a host/organisational structure for many of the activities.

The main audiences that have been addressed by TEN-34 are:

1. The partners in the TEN-34 Consortium: the European national research networks (NRNs). Both at a management and a technical level.
2. Prospective users of TEN-34, researchers connected to the NRNs
3. The press
4. The general public
5. Related projects and initiatives in Europe
6. European organisations with an interest in TEN-34
7. Organisations/initiatives with a similar interest in other continents

The means that are used to communicate information about TEN-34 are the following:

1. World Wide Web pages on the DANTE web server
2. A brochure and map of the TEN-34 network
3. Presentations at conferences and events
4. Publication of papers presented
5. Presence at exhibitions
6. Press releases
7. Other publications
8. Participation in EC organised events and publicity

Each information category is discussed in some more detail below.

2. World Wide Web pages on TEN-34

Several sets of web pages with TEN-34 information have been established and are maintained on a daily basis. The graphs below show a steady increase in the number of visits to both the TEN-34 homepage and the directory with TEN-34 files as a whole.

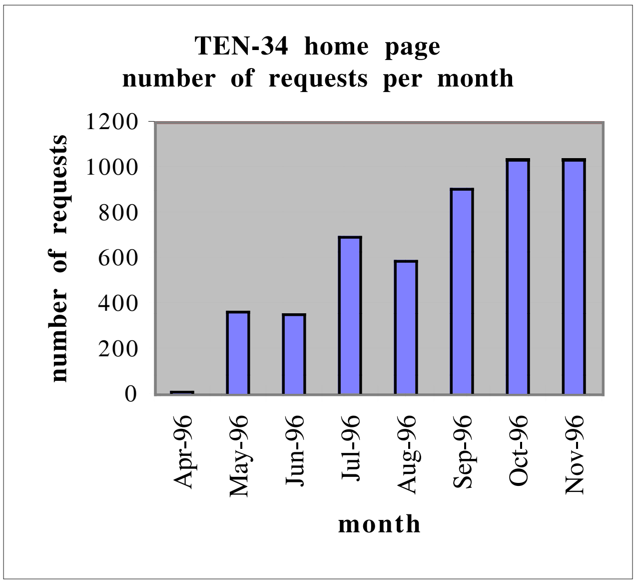

Figure 1. Number of requests for the TEN-34 homepage <http://www.dante.net/ten-34> per month, April-November 1996

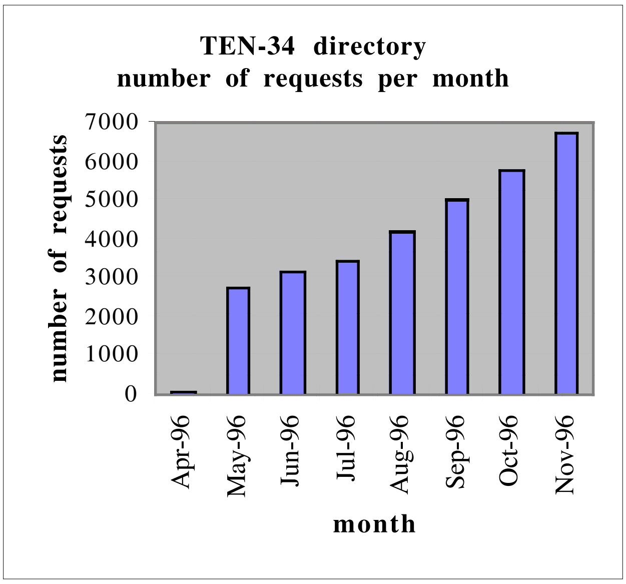

Figure 2: Total number of requests for all files in the TEN-34 directory per month, April-November 1996

The TEN-34 homepage

The TEN-34 homepage (URL: http://www.dante.net/ten-34, see also Annex 1) offers links to the most important elements of the project: an introduction to the project as a whole, the TEN-34 network, and the ATM testing element, an overview of publications on TEN-34 as well as an overview of project management activity, and a link to other relevant information sources such as the NRNs and the SCIMITAR Project (Support and Coordination for Integrated Multimedia Telematics Applications for Researchers).

This information is targeted at a broad audience but also offers access for audiences with a particular interest, e.g. in the ATM testing program as part of the TF-TEN activity. It also offers the possibility to order a paper copy of the brochure/map.

To explain the necessity for TEN-34, links have been established with information about national high speed research networks, as provided by the NRNs on their servers. This makes it easier to understand why a complementary pan-European interconnect facility such as TEN-34 is so urgently required.

In principle all information that is made available on paper is also included on the web server, e.g. an electronic version of the TEN-34 brochure and map, as well as all the papers that have been published and which are available to the public free of charge. A form on the web allows people to order hard copies of the papers on TEN-34.

The TF-TEN web pages

A second set of pages provides information on the TF-TEN testing program (URL: http://www.dante.net/tf-ten) see also Annex 1). Originally set up to support the participants in organising and managing the testing activities, it also serves to provide information to a more general audience as it is freely accessible and linked to other TEN-34 information. It contains contact details and meeting information as well as technical background information on the tests and their results.

This server has links to relevant other organisations and initiatives, such as TERENA, the Lower Layer Technology Working Group of TERENA and JAMES, the server of the experimental ATM backbone provided by the European telecom operators on which the testing will take place.

The TEN-34 Tech web pages

The TEN-34 Tech homepage (see Annex 1) is different in that it is not publicized outside the partners in the project, due to the confidential nature of part of the information provided. The Tech pages are not linked to any other part of the TEN-34 information. It contains detailed network implementation plans, drafts of confidential deliverables, minutes of meetings and contact details of the participants in the Tech group.

Secure directory for the TEN-34 Management Committee

For the management representatives of the participating organisations there is a secure directory where all the TEN-34 documents are stored. Documents can be easily downloaded via the web. In addition a weekly overview of TEN-34 activities is provided in 'More on TEN-34' (URL: http://www.dante.net/ten-34/mot-34.html) which includes: meetings held/planned and documents produced every week with links to these documents in the secure directory.

Secure directory with implementation details

For telecom operators involved in TEN-34 a special page was created to discuss contractual aspects of the ATM VP subnetwork part of TEN-34. This page has restricted access.

3. Brochure and map of the TEN-34 network

In September 1996 a brochure/leaflet describing the TEN-34 project including a picture of the planned network topology of the network was issued (see Enclosure). Around 1500 copies of this document have been distributed to: the TEN-34 Partners, press contacts, individual requests via the web server, and to visitors at the events and exhibitions where

TEN-34 was presented. In particular the map is popular as it shows how big TEN-34 is and how many countries in Europe are covered.

4. Presentations/papers at conferences and events

Between March and December 1996 eleven presentations were held by TEN-34 representatives. The scope of the events ranged from workshops of the National Research Networks to conferences on the role and future of the Internet, new technological developments in the Internet and conferences/exhibitions focusing on specific EC programs, such as Phare or Telematics. (see Annex 2 for a list of presentations on TEN-34 made so far). Slides of presentations are available upon request.

Most of the presentations were given on request, which shows an increasing awareness of TEN-34 and the role of the National Research Networks and this particular project in progressing the pan-European research Internet.

5. Publication of papers presented

All papers produced on TEN-34 are published. They are made available in HTML, Postscript and as hard copies and are available free of charge. The web page http://www.dante.net/ten-34/pp.html gives an overview of the TEN-34 publications so far. Copies of all the papers that have been published so far are attached in Annex 3.

6. Presence at exhibitions

Information on TEN-34 has been disseminated at two exhibitions so far.

The first exhibition was 'Managing Economic Transition' in Brussels in October 1996, a conference with a focus on Central and Eastern Europe. A very positive message to convey here was that partly due to Phare funding three of the Phare countries (Hungary, Czech Republic and Slovenia) are now ready to be closely involved in TEN-34. It could be shown that Hungary is already included in the TEN-34 implementation plan while the Czech Republic will be included in the next phase, while Slovenia has observer status in the TEN-34 Consortium.

In November 1996 TEN-34 was present at Globecom'96 in London where new developments in the global Internet were 'on exhibition'. TEN-34 was presented as a major new element in the global Internet. For this exhibition two new leaflets were produced which describe in more detail the technical implementation plan of the TEN-34 network (also available from the TEN-34 web pages, see also Annex 4) and the TF-TEN testing program. For this exhibition a few web pages were created separately to introduce visitors to the stand to TEN-34 as well as the role of the NRNs.

7. Press releases

Two press releases have been issued so far: the first when the TEN-34 Consortium was launched, on 16 May 1995, the second on 17 May 1996, to announce the signature of the contract by the EC. This second press release was not only issued in English, but translations in Dutch, French, German and Italian were provided as well with a view to reaching the largest possible audience. All NRNs were contacted with a view to distributing the press release within their country all on the same day, to maximise the impact on a European scale. A list of international press contacts used by DANTE is attached in Annex 5. Copies of both press releases can be found in Annex 6.

8. Other publications

An information channel used to provide information on TEN-34 on a regular basis is 'The Works of DANTE', DANTE's bi-monthly electronic newsletter. The newsletter has around 500 individual subscribers and is in addition sent to a number of international electronic mail distribution lists which cover a substantial part of the international research networking community, press, as well as interested 'outsiders'. All items on TEN-34 are collected and stored separately in a file which is available from the TEN-34 home page.

In addition, TEN-34 information is included in DANTE's Annual Reports (1994 and 1995). This publication is distributed to a general audience, the press, at exhibitions and within the NRNs.

9. Participation in EC organised events and publicity

TEN-34 has been (re)presented at the following meetings/conferences organised by the EC:

- 1st Telematics for Research Concertation meeting - 18 March 1996
- 2nd Telematics for Research Concertation Meeting - 14 November 1996
- Annual Concertation Meeting of the Telematics Applications Program - 2/3 December 1996

TEN-34 contributes information to the following projects which support the Telematics program:

ETHOS	The European Telematics Horizontal Observatory Service <http://194.70.69.3:80/ethos/>
SCIMITAR	Support and Coordination for Integrated Multimedia Telematics Applications for Researchers <http://www.scimitar.terena.nl/scimitar/>
ADVISOR	Added Value Information Services on European Research Results <http://adviser.csata.it/adviser/>

10. Project Information Material: plans for 1997

TEN-34 is expected to become operational in March 1997. For this purpose a launch event will be organised, probably in April. This will give the opportunity to further raise the visibility of TEN-34 and the parties involved. Another press release will be issued on this occasion. In addition, by the time of the launch an update of the first brochure will be available.

TEN-34 representatives will be in Edinburgh at the 8th Joint European Networking Conference in May 1997, where several presentations on TEN-34 will be given. TEN-34 will be promoted in a booth during this event and a demonstration is tentatively planned.

Other activities, such as the web pages, publication of papers and presentations, exhibitions and contacts with the press will continue in 1997.

Furthermore TEN-34 expects to be present at all forums and events organised by the EC in the context of either the Telematics or the ESPRIT Program.

References

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

TEN-34 papers published in DANTE IN PRINT:

#20. TEN-34: A 34 Mbit/s Infrastructure for European Research
Dai Davies, March 1996, ATM Europe 96, 19-21 March 1996, Paris

#23. TEN-34 and JAMES: Technical Plans
Michael Behringer, May 1996, for JENC7, the 7th Joint European Networking Conference, 13-16 May 1996, Budapest, Hungary.

#25. ATM and the Internet - A Service Provider Perspective
Michael Behringer, July 1996, for ATM - Developing the Broadband Future 1996, 2-4 July 1996, Paris.

#26. The challenges of building the pan-European Optoroute for research
Dai Davies, October 1996, at Optoroute'96, 16 October 1996, Paris.

Annex 1: home pages of the main TEN-34 web pages

Annex 1: The TEN-34 homepage: http://www.dante.net/ten-34

PROJECT AND CONSORTIUM

The TEN-34 Consortium is a grouping of sixteen national (and one regional) European research networks with DANTE as coordinating partner. In collaboration with ten European telecom operators and under contract with the EC (Fourth Framework - Telematics for Research/ESPRIT) they work on the setting up of a high speed pan-European interconnect facility between the national research networks.

- A brief description of the TEN-34 network implementation plan
- The TEN-34 brochure/map - to order a paper copy send a message with 'send TEN-34 Map' in the body [AND your postal address] to *dante@dante.org.uk*
- National High Speed initiatives
- TEN-34 Deliverables
- Progress in TEN-34 as reported in 'The Works of DANTE'
- Publications/presentations on TEN-34
- *MORE ON TEN-34* - weekly updates on TEN-34 activities.
- As part of TEN-34 the Task Force TEN is involved in the testing of advanced ATM services at a pan-European level over the JAMES experimental network.

TEN-34 is one of the Projects supported under SCIMITAR.

DANTE produced a blueprint for the next generation pan-European research network as part of EuroCAIRN in 1995.

[November 1996]
Contact: J.Bersee@dante.org.uk

Annex 1: The Task Force TEN homepage: http://www.dante.net/tf-ten

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Task Force TEN Homepage

The TF-TEN is organised under the umbrella of the TERENA working group on Lower Layers Technology (WG-LLT). The goal is to organise and carry out testing of advanced ATM technology over the JAMES ATM network in the framework of the TEN-34 Project. The detailed Terms of Reference can be found as well on this server.

Contact Information

- TEN-34 contact persons in the National Research Networks Who is when on holiday?
- JAMES contact persons in the PNOs

Experiments planned by TEN-34

- Project Plan (PS): Gantt chart giving an overview of the whole test programme planned by TEN-34.
- Experiment Descriptions: Detailed descriptions of each of the planned experiments.
- Overlay Network: VP infrastructure planned to support the experiments. See also the JUD (Word or PS)

Technical Information

- JAMES: The official home page.
- Acronyms used in the TEN-34 project.
- Network Maps: Relevant maps for this task force, e.g. the national set-ups
- Equipment: Available equipment in the NRNs
- Papers: Relevant publications for this TF

Organisational Information

- Mailing List: tf-ten@terena.nl; To subscribe send message with "subscribe tf-ten <your name>" in body to mailserver@terena.nl.
- Next meeting: 30-31 October 1996, Luxembourg, LU.
- Draft Agenda of next meeting.
- Minutes: Previous Meetings.
- Actions: Open Actions.

Last Update of this web-site (including the sub-tree): 2 December 1996
Comments to Michael Behringer, E-Mail: M.H.Behringer@dante.org.uk

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Annex 1: The TEN-34-Tech homepage (restricted access)

TEN-34-Tech Homepage

The TEN-34-Tech group consists of technical experts of the NRNs in the TEN-34 group and is responsible for the technical implementation of the TEN-34 planned infrastructure.

Note: All documents in this section are working documents and do not necessarily reflect any decisions taken by the TEN-34 Steering Group. It also should be noted that the content of these documents is primarily technical, without the necessary commercial and/or political context.

- Documents: Working papers for this group.
- PoP Details: Precise description of all equipment in each PoP
- TEN-34 APMs (access port managers) in the National Research Networks
- Meeting information

  Minutes of previous meetings.
  Next meeting: (no meeting currently planned)
  Actions: Current actions.

- Mailing List: ten-34-tech@dante.org.uk. To subscribe send message with "subscribe ten-34-tech <your name>" in body to ten-34-tech-request@dante.org.uk.

Last Update of this web-site (including the sub-tree): 21 November 1996
Comments to Michael Behringer, E-Mail: M.H.Behringer@dante.org.uk

Annex 2: 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
Monday 14 October 1996, Catania, Italy

The Challenges of building the pan-European Optoroute for Research*
Dai Davies
Optoroute'96, Grenoble, Wednesday 16 October 1996

Building the pan-European information superhighway for research
Dai Davies
Asia-Pacific Advanced Network (APAN) Workshop, Tokyo, Japan
Friday 8 November 1996

Broadband Telematics Infrastructure
David Hartley
First Annual Concertation Meeting of the Telematics Application Programme, Mon/Tue 2-3 December 1996

The titles marked with an asterix are included in Annex 3.

Annex 3: Papers published on TEN-34.

TEN-34: A 34 Mbit/s Infrastructure for European Research

Dai Davies
General Manager, DANTE

TEN-34 - The background

DANTE (Delivery of Advanced Network Technology to Europe Ltd) was established and is owned by the National University Networks to provide international network services to complement the network services they provide on a national level. As its name implies DANTE is interested in advanced technology and so Asynchronous Transfer Mode (ATM) is high on the company’s agenda of technologies to implement. Unlike our owners, who can generally insist on a single vendor solution to their networking problems, DANTE has to deal with a potentially diverse set of hardware. The problems of multi-vendor implementation are among the issues that we have to solve.

The research network community is probably the most demanding in terms of network technology. Nationally, throughout Europe, plans are well advanced for the implementation of high speed networks. There is real operational experience of broadband networking and many of the multi-media applications that demand higher network speeds and performance are being developed by this community. The research community is already able to demonstrate multi-media applications as diverse as multi-media mail and broadcast teleconferencing. This is, however, all implemented on a platform based not on the advanced ATM networking technology but on good old fashioned Internet Protocols (IP).

There is a further major challenge in providing advanced networking facilities to researchers in Europe. This is the lack of availability of bandwidth at what in Europe are regarded as higher speeds. International 34 Mbit/s circuits are hard to find and when they are on price lists they are expensive and the search for a reference sale is as elusive as the Holy Grail. In contrast 45 Mbit/s is a routine offering in the USA. where such facilities have been available for several years now.

This is the networking context for the TEN-34 project. TEN-34 stands for: Trans-European Network Interconnect at 34 Mbit/s. The project is supported by the European Commission under the Fourth Framework Program. Its main aim is to provide a ubiquitous pan-European 34 Mbit/s network to connect together all the national university networks. DANTE is the co-ordinating partner of the project. TEN-34 has two principal technology goals. Firstly to establish a 34 Mbit/s IP service based on an underlying infrastructure of ATM and leased lines. In this context the ATM technology is only used as a multiplexing mechanism. The second goal is to pilot the use of ATM technology to seek to exploit the practical benefits that it promises.

Internet versus ATM

ATM represents a major new technology. It has the potential to meet the emerging requirements of the generation of multi-media applications that are under development. Within the networking research community there is considerable interest in its usage. However, ATM will only succeed if it learns the hard lessons demonstrated by earlier networking technologies.

In contrast the research networking community's interest in Internet goes back to the protocol wars of the late eighties when connection oriented and connectionless devotees fought an ideological battle reminiscent of something out of Gulliver's Travels. Now that a truce has broken out and IP has proved to be for the moment the winner, it is relevant to consider the issues and challenges raised by ATM technology. ATM is a connection oriented approach which derives from the ordered world of the Telecom's operator rather than from the precious anarchy of the Internet. Such a pedigree would tend to lead to a difficult birth for the new networking technology in the world of research networking, where the recent commitment has been to connectionless protocols.

Nevertheless ATM offers sufficient potential benefits that sections of the research networking community are taking ATM seriously, despite its pedigree. This is an indication that there are real issues and challenges relating to ATM. The third world war of the protocols is likely to be fought on these issues and challenges.

The last major development to emerge from the telecommunications standardisation stable was ISDN. It is possible to cast one's mind back to the heady days of the late seventies and early eighties when the conference circuit was full of details of ISDN technology and national plans for implementation of ISDN. In the more sober nineties when ISDN services are only just starting to become a reality, it is interesting to reflect that the only beneficiaries of ISDN to date have been conference organisers. Is ATM destined to follow the fate of ISDN? In practice there is considerable more technical merit in ATM than ever was the case for ISDN. ISDN represented a bid by the telephony world to take control of data communications. It failed because of this. In contrast ATM as a technology offers some real benefits.

The real benefits of ATM

The variety of multi-media and video applications now under development require significantly differing levels of bandwidth. It is possible, even in Europe, to dream of a world where bandwidth can be squandered in the same way that CPU power can be squandered today, but it is rather unrealistic. ATM offers the possibility to provide switchable isochronous bit streams. This is in practice an essential requirement to support multi-media applications. It is true that such applications run over IP today. This is, however, more of a tribute to the lack of Quality of Service expected by Internet users than it is to the appropriateness of IP to carry services which require synchronous transmission. No doubt this is one of the very issues the third world war of protocols will be fought on.

ATM offers two potential benefits over current switching and transmission technology. Firstly it is capable of providing a more flexible division of bandwidth enabling both synchronous and asynchronous connections to be provided on the same link. Secondly, as the switching technology develops, it will allow dynamic allocation of bandwidth to meet the requirements of individual applications, thereby permitting greater flexibility and more efficient use of network capacity. It is probable that the more ambitious pre-emption and negotiation algorithms are doomed to failure. Nevertheless, it can represent an improvement in resource allocation.

The real challenges of ATM

Here is one of the great challenges of ATM. A great success of Internet is fixed access pricing. It encourages some less than optimum usage of network resources and actually imposes Quality of Service by rationing rather than by price. But predictable bills are popular with users. If ATM services are expensive, never mind the fact that they can be managed economically, they will not prove popular. The technology cost reductions that are apparent in the personal computer market place apply equally well to telecommunications technology both from a switching and transmission perspective. The difference is that telecommunications prices, cosseted by a monopoly marketplace, have only reduced marginally. ATM represents a potential for future telecommunications services but will only succeed if the real cost reductions in technology are actually made available to the user.

The market for ATM needs to be driven by increasing supply through low prices rather than by rationing demand through high prices. Users will stick to the simple Internet if demand is to be rationed. There is a major challenge to the emerging marketing departments of the European PNOs to see ATM as a commercial opportunity to be exploited rather than as a cash cow to be milked.

The second major issue is the lack of maturity in the technology. Although the basic ideas of cell relay are well understood, the control mechanisms that take a technology to the point where it can be used as a real service still require development effort. This lack of maturity is reflected in the European PNO ATM pilot where the facsimile machine was used as the signalling system. Facsimile is one of the few success stories of PNO standardisation efforts, but it was not really specified as a signalling system for advanced network technology.

Large scale international standardisation efforts do not have a good track record of success in creating international products. By contrast, where the market has been dominated initially by a single supplier who has been able to impose a de-facto solution, standardisation has proceeded quite quickly. The standardisation process for ATM has cut some corners. It will remain to be seen whether it will produce reliable products from a variety of vendors that will interwork. It is a measure of DANTE's belief in the need for this process to succeed that we are investing effort in establishing an ATM test network. It is also a measure of our scepticism that it will succeed that we need to invest such effort.

TEN-34 will provide some early benchmarks for success

ATM has the potential to meet the emerging requirements of the next generation of multi-media applications. However, there are serious challenges to its success. The standards must be there and be implementable. Shopping list standardisation, with many options and the potential for conformant implementations that will not interwork, will fail as it has always failed. If standardisation is truly effective and a multi-vendor market emerges for ATM hardware, there is a real chance for ATM, provided the telecommunications service providers address the market seriously with attractively priced products.

A major work item of the TEN-34 project is the testing of ATM initially as the basis for a data-transport mechanism, subsequently as a switching technology in its own right. The first phase of the project will define an acceptance test for the overall TEN-34 service. In parallel with this a suite of tests aimed at proving the operational capability of ATM and exploiting its benefits as both a switching and transmission technology will be defined co-operatively with the JAMES consortium of PNOs.

In the context of TEN-34 the first pan-European ATM network aimed at the serious provision of service will emerge, providing some early answers and interesting experiences to the viability of ATM as a serious telecommunications technology. It is expected that TEN-34 will provide very valuable insight into the planning and operational implications of ATM and act as a performance and technology benchmark to its success.

TEN-34 and JAMES: Technical Plans

Michael H. Behringer

Abstract

The TEN-34 project will develop a high-speed backbone for the academic community in Europe. Last year DANTE defined its plans for such a network. Now the technical details are being finalised.

There are two parts to the TEN-34 project: A production IP network to cover the immediate needs for higher speeds, and extensive ATM tests to trial new services and migrate them to the production network at a later stage. These ATM tests will be carried out over the JAMES network, a joint initiative of the European PNOs.

This paper describes the technical details of the planned TEN-34 production network, and the outline of the ATM experiments over JAMES. It also outlines the future technical plans for the project.

It was originally planned to include technical details of the JAMES network. This has not proved possible, as the commercial discussions were not finished at the time of submission of this paper.

Commercial and other non-technical issues are not discussed here.

Keywords: TEN-34, JAMES, IP over ATM.

I. TEN-34 Overview

Last year DANTE put forward its plans for the implementation of a high-speed network for the European research community [EuroCAIRN95, Behringer95]. The biggest single obstacle in this process was the unavailability of international 34 Mbit/s lines in Europe. Having outlined the requirements and plans for a high-speed network in Europe in 1994, a consortium with all involved European research networks was created: 'Trans-European Network Interconnect at 34-155 Mbps' (TEN-34) [TEN-34] with DANTE as co-ordinating partner. There are two distinct parts in the TEN-34 proposal: A high-speed production IP network and an ATM test network. On the production IP network two separate proposals for essentially independent networks evolved, which will be discussed in detail in the next section. TEN-34 co-operates with JAMES, a consortium of European PNOs, on the ATM test network. JAMES aims at continuing the ATM testing started on the European ATM Pilot in a similar organisational way. More advanced features of ATM such as VBR services and SVC are planned to be introduced during the lifetime of the project.

The basic principle of the TEN-34 project is to trial new services on the JAMES network and to migrate them to the production network once they are stable enough to be offered as a service. This two-tier approach aims at satisfying the needs for early available and reliable high-speed connectivity as well as for leading edge technologies.

II. The Production Network

The plans of TEN-34 were originally to start with a technically simple backbone based on E3 (34 Mbit/s) leased lines. Although these lines are now becoming available in many European countries, there are still a number of countries where they cannot be leased, or are too expensive. This solution was not acceptable, as TEN-34 needs to be able to cover all western European countries. There are however two independent proposals for network services which together cover most of Europe. One proposal came originally from the PNOs from France, the UK, Germany and Italy. This group was called "FUDI" after the initials of the two-letter country codes. The other proposal comes from the Unisource countries, namely the Netherlands, Sweden, Switzerland and Spain. It will be referred to here as the Unisource proposal.

II.A. The FUDI Proposal

The FUDI countries propose an ATM service that connects the four countries involved: France, the UK, Germany (DE) and Italy. There is a possibility to include Switzerland as well. As this network only provides ATM level connections, TEN-34 needs to organise routers to interface this ATM "cloud" and to provide an IP service to the NRNs. The full physical topology can be seen in figure 1.

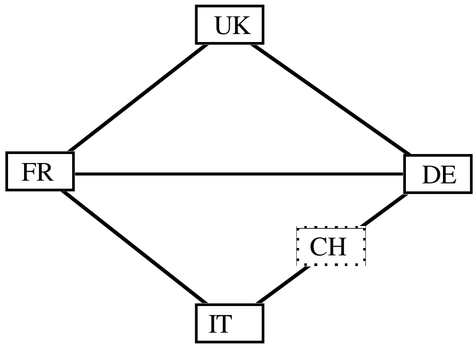

figure 1: Planned FUDI topology; the boxes are ATM switches.

Over this physical topology a set of VPs will be provided. Initially the plan is to establish only one VP per physical line to the immediate neighbours to avoid possible ATM problems. The routing would then be done purely on IP level through routers connected to the ATM switches shown. As there are no competing VPs in this set-up there will be no losses within the ATM network, but only on the connected routers, where packets and not cells will be dropped. This prevents internal cell losses which could damage the IP performance severely, especially since early packet discard will not be available initially.

At this stage the possible technical benefits of ATM cannot be used yet, because the virtual network corresponds to the physical one. The potential benefits would be the establishment of a full mesh of accesses with the efficient sharing of bandwidth between them. The problem with this approach is that the sustainable cell rate (SCR) of the VBR service specifies an average throughput that can be increased only for very short periods to the peak cell rate (PCR). This means that on the IP level an increase of capacity beyond the SCR limit will probably not be noticeable, because the PCR will only last for very short times, then ATM will pause the stream to get back to the SCR average. A potential solution to this problem would be an ABR service, but this is not available yet.

The FUDI proposal does not include the management of the routers that are needed to provide an IP service over this infrastructure. One of the main problems in the service specification is therefore the agreement on ATM traffic parameters that are suitable to support an IP service. The providers of the ATM infrastructure will not guarantee any IP level parameters, as they do not have any influence on this level. To be able to work around possible problems the TEN-34 partners insist on a technically simpler fallback solution.

II.B. The Unisource Proposal

Unisource proposes an IP service based on E3 leased lines that covers at least the Unisource countries, the Netherlands, Sweden, Spain and Switzerland. This IP service will be shared with other users, which means that the other parts of the TEN-34 network need to be set up in such a way to be able to filter out third parties on Unisource over e.g. the FUDI part of the network. This prevents for example the TEN-34 routers around the FUDI network to be in the same AS as Unisource.

The planned topology can be seen in figure 2. Possible extensions are from the Netherlands to Germany, and from Sweden to the UK. These extensions have not been decided yet.

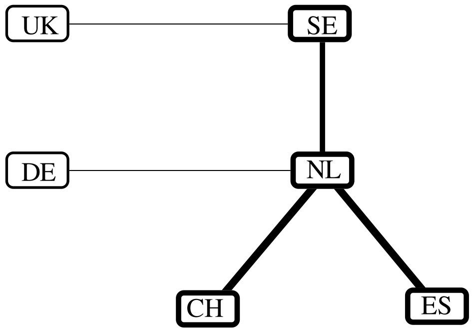

figure 2: Planned Unisource topology; the boxes represent routers; the bold parts show the Unisource main countries.

The Unisource routers would be on Unisource PoPs, from where local loops would extend the network to the National Research Network sites. This is the normal network set-up as used in most backbones today and should therefore not present any problems.

At a later stage however the TEN-34 network as a whole should provide the capability to support ATM based applications. The Unisource part of the backbone would then have to be migrated to an ATM platform, which would change the characteristics of the currently planned topology significantly. At the time of submission of this paper this point was not yet clarified.

II.C. Planned Interconnection

As long as the Unisource side is not based on ATM, the interconnection between the FUDI and Unisource part of the network has to be on IP level. If there are no countries where both networks overlap (the extensions of Unisource are not final yet, neither is the inclusion of Switzerland into the FUDI network), TEN-34 has to organise interconnections, presumably in form of E3 leased lines. For reasons of resilience at least two fully independent - i.e., involving four countries - interconnections are desired. Estimated traffic flows from the National Research Networks show that at least two and possibly three interconnections would be needed.

To be able to interface the FUDI network on IP level routers are needed at each FUDI location. These TEN-34 routers could connect the lines to the Unisource backbone where appropriate, the local loop to the according National Research Network, and the VPs over the FUDI ATM infrastructure. From a management point of view they would be under the operational control of an organisation other than Unisource, the likeliest possibility at this moment is that one of the National Research Networks manages the TEN-34 routers. This way the TEN-34 operator would interface with Unisource and FUDI separately. Once Unisource migrates to ATM direct interconnections will be possible and desired, but no agreement on this issue has been reached as of today.

II.D. Planned Topology

Including the interconnections, the currently planned topology is shown in figure 3.

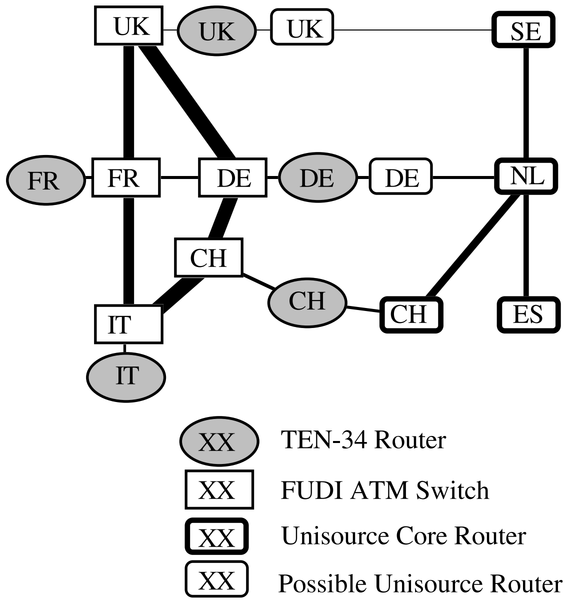

figure 3: Planned TEN-34 topology

In the case of DE and UK it is not clear yet if Unisource will provide the extensions from their main backbone (bold) to those countries. If TEN-34 has to organise these interconnections, then there won't be Unisource routers in the UK and DE.

The National Research Networks connect in the "Unisource only" countries (NL, SE, ES) directly to the Unisource router, in the other cases to the TEN-34 router.

The AS set-up will be such that all Unisource routers are in an AS solely managed by Unisource. In the case of the TEN-34 routers the plan was originally to have them in one TEN-34-AS. It was decided later that each TEN-34 router should be in a separate AS, to enable easy load distribution over the interconnections. The solution to keep the TEN-34 router in each country in the AS of the NRN was dismissed as TEN-34 backbone routing has to be kept separate from national routing policies.

Countries not shown in figure 3 have a choice to which backbone they want to connect. The cost, combined with the reliability is the main driving force there.

Intercontinental connections are being dealt with outside the framework of the TEN-34 project. Several proposals are being discussed, which all centre around the provision of two independent 34 Mbit/s or 155 Mbit/s lines to different locations in Europe. Essentially the cost and the distribution of the bandwidth inside Europe are the main inhibiting factors.

III. ATM Experiments

While the production network will satisfy the immediate need for higher speed connections, new applications and networking technologies will be trialed to be installed later on the production network. The technological platform that will support most of these applications is ATM. In the beginning of the project a dedicated ATM test network was planned. Due to the high costs of a backbone dedicated for this purpose this proposal was dismissed and it was decided to use the infrastructure of the JAMES project.

II.A. Overview of JAMES

By the time of writing this paper the JAMES project was not finally approved yet. It has to be understood that the project plans might change or in the worst case that it will not be approved at all. Due to this uncertainty it was not possible to obtain a detailed official description of JAMES.

JAMES is a joint project in which most of the western European PNOs participate to trial and pilot ATM network services. The predecessor of JAMES was the European PNO ATM Pilot, which ended in December 1995. It is understood that JAMES will initially carry on offering the ATM services of the European PNO ATM Pilot, and gradually introduce new ATM features such as VBR and SVC.

II.B. Testing ATM over JAMES

To plan and organise the ATM experiments a new Task Force was created under the framework of the TERENA Lower Layers Technology working group. This "TF-TEN", in which technical representatives of the National Research Networks participate, defines which new services are desired by the NRNs and what experiments are to be carried out to test those. In addition technologies are to be tested to find optimal configuration parameters.

Initially planned experiments include:
- IP over VBR performance tests. *The goal is to get a thorough understanding of the interworking between the main VBR parameters such as SCR, PCR and MBS and IP performance, especially on competing VPs.*
- CDV Tolerance Tests: *The goal is to identify possible problems with differences in the cell delay variation on the interface between networks.*
- Native ATM performance testing: *The goal is to find out how native ATM applications behave across several networks some of which impose long delays.*
- ATM ARP and NHRP testing*: The goal is to identify issues with these protocols over long distances, i.e. in the range of thousands of kilometres.*
- Advanced application testing: *The goal is to identify new applications that are needed on an international scale and to test them.*

In some of these cases results from other projects are available. It is not the intention to duplicate work, therefore results of other test will be used where applicable. It is however felt that confirmation of other results is needed, if only to verify that the different working environment does not have an impact on the results.

The migration to the production network will depend on the deployment of ATM on the Unisource side. This, and also changes to the FUDI network are subject to further negotiations with both parties. This is still ongoing, thus no detailed technical plans for the migration have been made yet.

IV. Future Plans

Taking general current growth rates of Internet traffic into account, and considering that many European countries are about to make a step from a 2 Mbit/s infrastructure to a 34 Mbit/s infrastructure, a 34 Mbit/s backbone in Europe will not suffice for very long. One of the most important steps is therefore the extension to higher speeds than E3. This issue has to be taken up very soon.

With regard to technology a lot depends on the outcome of the ATM tests. Currently the expectation is that ATM will provide a useful service to attractive prices. On the technical side it remains to be seen how new IP developments such as RSVP will compete with ATM technologies.

V. Summary

TEN-34 and JAMES are both establishing networks based on E3 speeds throughout Europe. TEN-34 focuses on a production networking service for the European R&D community, which will initially be an IP service. This network is currently being put in place to serve the immediate needs. It consists of two technically independent parts, one of which will be based on ATM, the other one is going to be a native IP service.

In parallel the TEN-34 project trials new ATM features such as VBR and SVC on a European basis, with the goal of migrating those services to the production environment at a later stage. These ATM experiments will be carried out over the JAMES network, which is an experimental network put in place by the European PNOs to trial and pilot ATM services world-wide.

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[TEN-34] TEN-34 is a Telematics/ESPRIT project, co-funded by the European Commission under the 4th Framework Programme.

ATM and the Internet - A Service Provider Perspective

Michael H. Behringer, DANTE

Abstract

The Internet as we know it today has been built mainly on leased lines. Since ATM has become available some parts of the Internet were shifted to an ATM based platform, mainly to make use of the added flexibility offered by ATM. The advantages and disadvantages of ATM and IP are heavily discussed amongst experts, leading to sometimes semi-religious disputes. A service provider must make decision on new technologies rather more emotionless. From this perspective a shift to a new technology like ATM is only feasible if either his customers require this technology or if there is a cost advantage. Today the major benefit of ATM is flexible bandwidth assignment, but the cost are still such that they prevent general use of the new technology. For the future ATM promises features that at least the current version of the Internet Protocol cannot offer. It remains to be seen if and when these features will be mature and what at what price they will be delivered at.
Keywords: IP over ATM, Internet Service Provision

The position of Internet Service Providers

From a commercial perspective the introduction or use of a new technology must be justified by either customer demand or because the innovation is more cost efficient. Through the new technology the IP service provider might be able to offer new services to his customers or bring the price of existing services down. ATM promises new transmission techniques that are not currently available on the Internet, or could be implemented only at very high cost. The question for an Internet Service Provider is if there is a demand for these new services, and if ATM services can be used in a way to reduce the operational cost of his network compared to using leased lines.

In theory there is also the option of service providers buying leased lines and switches, and providing the ATM service themselves. This is an expensive way of providing the service. Not only does the provider loose the ATM cell headers as overhead, also this requires additional equipment, which is expensive even though the price for equipment is small compared to the cost for leasing lines. Therefore this will be limited to exceptional cases. In general IP service providers are likely to buy an ATM service from a public carrier, and can therefore be considered ATM users in this context.

ATM Today

The ATM services that are on offer today are mostly limited to continuous bitrate services (CBR) and variable bitrate (VBR) services. For the provision of an IP service both are in principle suitable. (For a detailed discussion see below.)

Due to a lack of signalling standards these are the only traffic classes and services that ATM offers today to the IP service provider. For the provider this means that up to now the only technical benefit of ATM over leased lines is the fact that the assignment of bandwidth is not limited to the standard leased line transmission speeds any more, and that the allocation of ATM channels should be faster than with traditional leased lines. The customer only benefits if he has a requirement for dedicated bandwidth.

So far the cost of ATM services in Europe are too high to allow for general use of the new technology. In most cases the price per Mbit/s transmission capacity is higher on an ATM service than over leased lines. In addition to the cost, ATM leads to an additional overhead on IP level (see below for details). Therefore ATM is currently only in use in IP networks where there is a need for flexible bandwidth assignments, or where transmission speeds are required that are not otherwise available.

IP over ATM: Technical Problems

The first problem usually mentioned when using IP over ATM is the overhead. The ATM overhead consists of three parts, the ATM cell header (4 bytes for 48 bytes payload), the AAL header (for AAL5 this is 8 bytes per IP packet), and the padding to fill the last cell of an packet. The total overhead depends on the size of the IP packets. Values between app. 15% up to 30% and more can be observed. The overhead of the ATM cells should be carried by the ATM provider, such that the ATM bandwidth sold should not include the ATM header. This leaves the AAL header and the padding, which are not a severe problem for general IP traffic with an average packet size of app. 200-300 bytes. It also has to be noted that TCP/IP has a big overhead (40 bytes per packet), but for the foreseeable future these protocols will be needed by the applications.

Almost all applications that are in use over today's Internet require the TCP/IP protocol stack. Native ATM applications are being developed but are far from being used on a wide scale. Therefore IP is needed on the Internet for the foreseeable future, and if ATM is to be used as a transmission technology, it has to be added to the protocol stack rather than replacing parts of it. There are a number of problems with running IP over ATM, which are partly due to the fact that ATM is connection oriented while IP is connectionless.

VBR looks at first glance like a suitable traffic class for an IP service, because it offers a guaranteed sustainable cell rate (SCR) with the ability to peak to a defined peak cell rate (PCR). This in itself would be a significant advantage over the leased line approach. It has to be noted though that despite a VBR service is capable of bursting to the PCR, this is generally not noticeable on IP level. The reason for this is that the PCR can only be sustained for a defined number of cells (maximum burst size, MBS), after which the traffic needs to stop for some time to get the average down to the SCR level. Therefore VBR does not offer a significant technical advantage over CBR services if IP is used on top of it.

IP traffic is comparatively tolerant to packet losses, but even a small cell loss on the ATM layer can bring the useful IP throughput down to almost zero. This is because IP packets are mapped through an ATM adaptation layer (AAL) into cells. One single IP packet can be up to 9k bytes and more, which fills up a large number of cells. If only one of the cells needs to be discarded in the ATM network, the whole packet needs to be re-transmitted. Therefore ATM networks need to have a very low cell loss rate, to make the use of IP possible. A cell loss rate of 10^-9 is acceptable, with 10^-8 the loss is noticeable, but working is still possible, from 10^-7 and more the losses are experienced as problematic. There are techniques under development where the AAL has knowledge of the IP layer structure and can discard whole packets if needed (early packet discard, EPD). These are not yet generally in use.

Other problems come with multicasting, where the ATM approach is different to IP, because ATM is connection oriented. These can be solved, but require significant changes from the IP approach.

None of these problems means that ATM would not be suitable to carry an IP service, but as long as the use of ATM does not bring a significant commercial advantage and as long as it is not really needed by the customers, service providers will use the simple and well known technology of leased lines whenever possible.

ATM in the Future

A number of ATM services that are under development today look attractive to the provision of an Internet backbone. Switched virtual circuits (SVC) combine the advantages of quality of service of the CBR and VBR classes with the quick availability of transmission capacity on the Internet. The signalling standards are still under development, and more time will be needed to advance the working technology to operational standards. From an Internet perspective this tendency is seen with mixed feelings: The need for high quality of service on demand is certainly acknowledged, but it will lead to usage based charging, a model so far disliked in the Internet world. From a provider perspective though the demand will drive the development, and there is little doubt that this service will be used if the prices are reasonable.

As mentioned above, VBR services do not provide the level of flexibility users are used to on the Internet. On IP level, the bandwidth increase to the peak cell rate is far too short to be even noticed. The available bitrate service (ABR) of ATM seeks to offer this flexibility by making the full physical speed available if no other virtual circuit is using it. This traffic class is also under development. Whilst this comes close to the wishes of the Internet users, it is unclear if and how PNOs will make this service available. From past experience it can be seen that PNOs are not necessarily offering this additional free bandwidth. This can be seen with the Frame Relay services on offer today: In theory PNOs could offer very high peak rates, in practice they are reluctant to offer more than twice the average rate for peak traffic, even if there is still spare bandwidth available. If the same approach is chosen on ATM ABR services, this will limit the usefulness of ABR, despite it will still be more attractive than VBR for the provision of Internet capacity.

Another possibility is that ATM will be used end to end, with applications running natively on ATM. There is still a long way to go for this to happen. Firstly, addressing issues will have to be resolved. Not only would that require to change from the IP numbering scheme to a new architecture, but there are already two schemes in use, E.164 and NSAP, which will make address translation necessary. Then, ATM routing is also far from being deployed in a service environment.

Possible Directions of the Internet

As of today it is not clear how the Internet will develop. It can already be seen that ATM is being used in parts of it, which points out clearly that there is a need for technical additions to the current IP protocol. This need comes from the desire to get quality of service, which cannot be achieved over the current Internet. The Internet will certainly not remain a pure IP over leased lines infrastructure, and as can be seen today there is scope for ATM.

Sometimes voices can be heard that IP will disappear altogether in the end. But for ATM to take over the full functionality of today's Internet many more issues would need to be addressed. The multicasting structure of the Internet cannot be easily transferred to an ATM network, because ATM is connection oriented and has therefore a different technical approach to multicasting. Up to today, there are almost no native ATM applications, and even if ATM is used as a transmission technology IP is used to route the traffic. It is very questionable if ATM will ever take over the Internet completely, neither is it obvious that this is desirable. But we are certainly years away from even having major parts of the Internet running without IP. And certain parts of the Internet will probably never be replaced: The domain name system is one if those.

But what about IP next generation?

The next version of the Internet Protocol that is currently under development will not only address the size of the address field, but also try to deliver the quality of service needed. The resource reservation protocol is the attempt of the Internet community to solve the problem of lacks of bandwidth guarantees in the IP protocol. As with ATM, it will take a long time to get the new protocols to a standard where they can be deployed in an operational environment. The market will decide in the end which way the Internet will go. Fast availability is certainly a key issue here.

Summary and Conclusion

Currently the benefit of ATM for Internet service providers comes with the flexible bandwidth assignment possibilities. As the price for ATM services in Europe is still very high, ATM is only being deployed where there is a need for bandwidths that cannot be obtained otherwise. The traffic classes available today do not offer specific benefits to the Internet provider.

As to the future, the market will decide what role ATM will play on the Internet. This depends on what PNOs are going to offer and to what prices, and if there is a general need for the services from the Internet perspective

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* TEN-34 is a Telematics/ESPRIT project, co-funded by the European Commission under the 4th Framework Programme.

The Challenges of Building the pan-European Optoroute for Research

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DANTE, General Manager
October 1996

The research networks which connect together universities and research institutions in the various European countries are a key stimulus to the development of the European economy. These networks provide both a vehicle for researchers in the various disciplines to co-operate as well as the building blocks for research into telecommunications and information technology systems. The USA has demonstrated very convincingly through the efforts of the National Science Foundation how effective research networking can be for the benefit of industry and society as a whole. New telecommunications industry which has given rise to such firms as CISCO, Bay Networks and Netscape has resulted from NSF investment in Internet technology. Europe has very happily employed this technology and has even contributed considerable voluntary manpower to assist in its development.

In contrast Europe has been slow to build an equivalent of a pan-European facility to support research and researchers. It is only really with the fourth framework programme of the European Commission that research networking has come to be seen as an element of European industrial policy. Each country in Europe has a data communications network that interconnects its national universities. In France this is RENATER. These National Research Networks (NRNs) have had some success in building national high speed data networks to interconnect the universities. The most advanced of these networks, SuperJANET in the United Kingdom, can offer 155 Mbps interconnection to a number of sites. Developments in other countries are similarly moving towards higher speeds that will allow development and implementation of multimedia applications to support research.

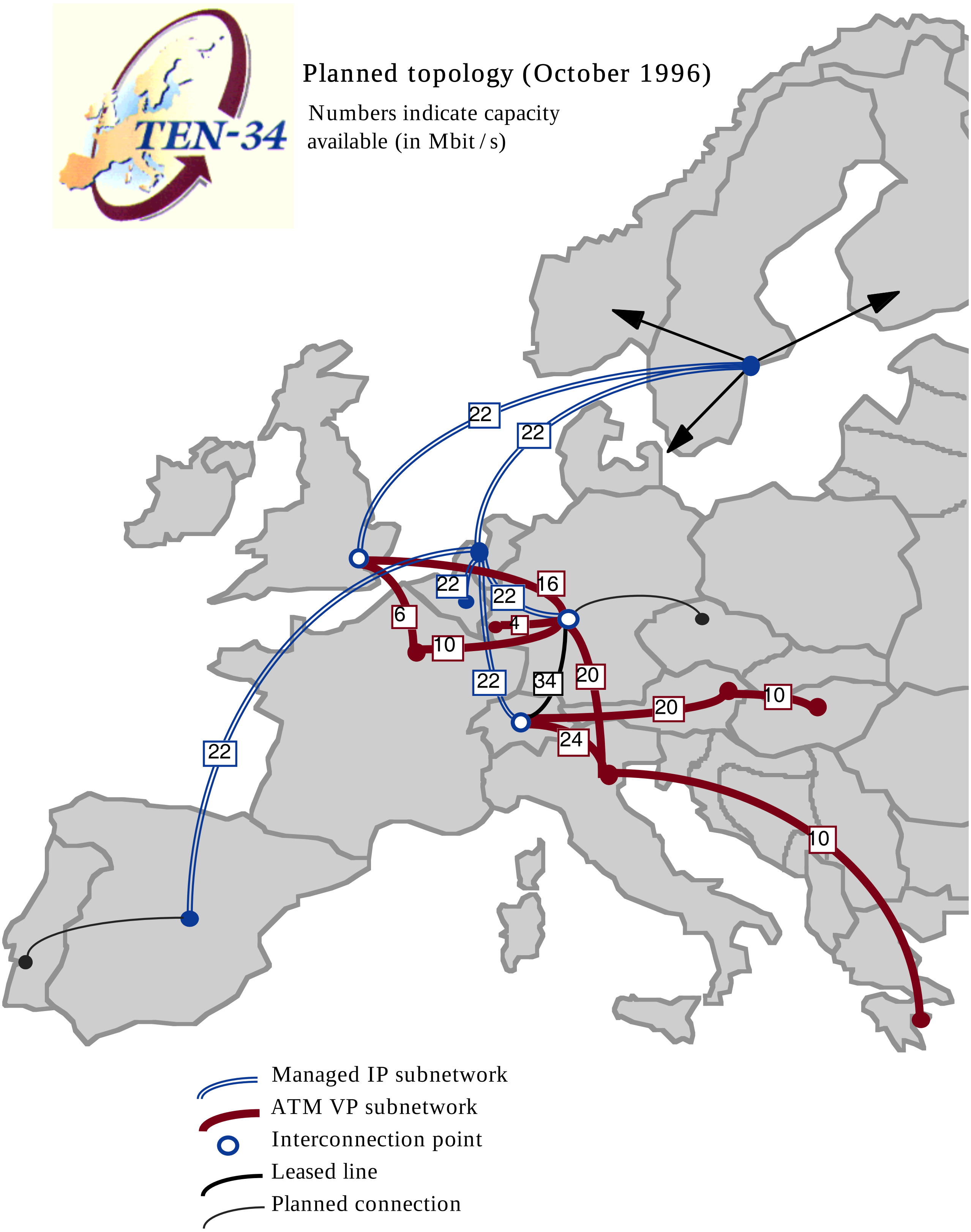
The contrast between national capability and pan-European capability is quite stark. Nationally, there existed a number of networks operating at 34 Mbps and several with 155 Mbps capability. On a pan-European level, EuropaNET the pan-European research network organised by DANTE on behalf of the research community, can support connectivity at 8Mbit/s. It is to provide a matching European capability for the interconnection of national research networks that the Trans European Network Interconnect at 34 Mbps (TEN-34) project has been organised under the fourth framework programme (Telematics/ESPRIT). This will create "the pan-European Optoroute for Research"

TEN-34 is a co-operation of all of the western European research networks and today includes Hungary from central and eastern Europe. It is a major step forward in building the pan-European Optoroute for research. As the co-ordinating partner of this project, DANTE has now considerable experience of the challenges of building such a network. At one level creating the pan-European Optoroute should be easy. There is in fact no shortage of international fibre optic capacity within Europe. As part of the preparatory work for TEN-34 DANTE surveyed the capacity that was available and installed. A number of telecommunications operators were reluctant to provide information but from the partial picture that emerged it is apparent that capacity itself is not a problem. Even a relatively small country such as Austria already has giga-bits of international capacity across its land frontiers and ambitious plans to increase this capacity. The difficulty lies not in the availability of capacity rather in the willingness of the owners of that capacity to make it available at sensible prices to the market place.

There are three key challenges that the TEN-34 project has had to meet in order to implement the plans for TEN-34. These are:-

1. Availability of Service

It is apparent that European supplier are today unable to provide a ubiquitous pan-European network operating at 34 Mbps. The reasons for this seem to lie in the current liberalisation of the telecommunications market in Europe. European PNOs rely disproportionately on international voice services for a significant part of their profitability. This is based on the monopoly prices that they are in a position to charge for such services. High capacity links of 34 Mbps or 155 Mbps would allow competitive bypass networks to make serious inroads into this profit stream.



As a consequence the market, collectively, has been reluctant to make available high capacity circuits on an international basis within Europe. Paradoxically liberalisation is in fact delaying its own process. The consequences of this for the TEN-34 project are that we will deal with fourteen service suppliers in order to create a pan-European network. For the past five years EuropaNET has been provided by a single telecommunications supplier. The price of progress is diversity of supply.

2. Cost

International telecommunications in Europe is expensive. A compelling proof of this is to look at the cost of transatlantic capacity in comparison with equivalent international capacity within Europe. It is a harsh fact today that the same capacity provided over 5,000 km of sea cable costs slightly less than for equivalent capacity on 500 km of terrestrial fibre within Europe. A price differential between Europe and USA of 10 is not unrealistic. This is not because Europe has less capacity. This is not because Europe has inferior optical technology. It is because of the development of the pan-European market place for telecommunications. By judicious negotiation TEN-34 has managed to reduce the overall cost per Mbit by up to 50% of its current level. Nevertheless the development of the Optoroute is constrained by price. The price of progress is the high cost of international telecommunications in Europe.

3. Availability of Technology

TEN-34 will use a mixture of leased circuits and ATM transmission capacity. ATM has a number of benefits over IP technology. In particular ATM offers the potential much improved management facilities and control of quality of service which are the Achilles heel of Internet. In practice TEN-34 will not be able to utilise these capabilities. Through co-operation with the JAMES project, a consortium of the existing European PNO's, a testing programme for ATM will be implemented. In general it is disappointing that more advanced ATM services can not be available as part of an integrated European service. The price of progress is conservatism in technology.

Summary and Conclusions

TEN-34 represents a major step forward for pan-European research networking. It will mean that the gap between the national telecommunications facilities available to European researchers and those available Europe-wide will be at least reduced. Nevertheless European research networking continues to be restrained by lack of capacity, by the cost of current capacity and the limited availability of ATM technology. The 'Ancien Régime' of European telecommunications continues to live despite the intention to create a liberal market within Europe. The challenges of building the pan-European Optoroute are essentially political and remain. If Europe is to emulate the success which the US has had in the use of telecommunications for economic and scientific success it has to address two major challenges.

1. Stimulation of a true European Market

Infrastructure is not a problem within Europe but access to it at sensible prices is. The de-regulation of telecommunications alone is not enough. To date de-regulation has had the effect of encouraging the existing operators to man the barricades against progress. There needs to be proactive regulation to dismantle these to ensure that a liberal and competitive market exists on a pan-European basis.

2. Research Networking as an element of Industrial Policy.

Europe needs to exploit the resource which research networks represent for the development of new technology and services. Too much effort is still focused on the traditional market players whose conservatism has been a bar to European economic success in telecommunications. The US example of using the research community to develop new and innovative products and services in telecommunications and information services has created the concept of the Information Superhighway and is providing the building blocks. Le défi américain est toujours là... Europe should learn from it and meet the challenge.

Annex 4: two technical leaflets on TEN-34

The TEN-34 network

The TEN-34 network is an interconnect facility between the national research networks (NRNs) in Europe, co-funded by the European Commission (ESPRIT/Telematics). It will offer a high speed pan-European backbone to complement an increasing number of high speed national backbones.

Technically, the TEN-34 network will consist of two subnetworks, connected at three points in Europe. One subnetwork is based on ATM Virtual Paths/leased lines and the other subnetwork is a managed IP network, provided by Unisource. TEN-34 is expected to become operational in the first quarter of 1997.

The ATM VP subnetwork

This subnetwork will connect the following national research networks:		The telecom operators involved are:
Renater	(France)	France Telecom
JANET	(UK)	BT (Worldwide) Ltd (Belgium)
DFN	(Germany)	Deutsche Telekom AG
GARR	(Italy)	Telecom Italia
SWITCH/CERN	(Switzerland)	Telecom PTT
GRnet	(Greece)	OTE
ACOnet	(Austria)	Post and Telecom Austria
RESTENA	(Luxembourg)	Enterprise des P et T Luxembourg
HUNGARNET	(Hungary)	MATAV

The services delivered to the TEN-34 partners by the telecom operators will be based on either ATM or leased lines. In order to provide an IP service to their customers, the individual NRNs will arrange for an IP service to be mounted over the services provided by the telecom operators.

Two modes of operation are available from the telecom operators - Constant Bit Rate (CBR) and Variable Bit Rate (VBR). The former is aimed at services in which timing is important, such as video-conferencing, while the latter is geared to less time sensitive, bursty applications such as data. Given that the performance criteria are more stringent in the case of CBR, the service is normally more expensive than a VBR service of the same average capacity. TEN-34 will be using VBR with Peak Cell Rate (PCR) = Sustainable Cell Rate (SCR) where this mode of operation is offered by the telecom operators, and CBR for the remaining links. This provides the most cost effective solution for the interconnection of the NRNs, whose international traffic is not bursty since it is the aggregated traffic of thousands of users.

The IP Service will be mounted using Cisco 7500 series routers, connected to the telecom operators' ATM switches or leased line via an appropriate interface. These routers have the ability to control the flow of data into the ATM network to match the contracted ATM parameters, so it is expected that there should be little loss of ATM cells due to the NRN networks exceeding their agreed ATM contracts with the telecom operators.

The managed IP subnetwork

The service delivered by Unisource will be an IP network service with advanced features such as native IP multicast. The Unisource routers will be on Unisource PoPs (Points of Presence), from where local loops would extend the network to the National Research Network sites. This is the normal network set-up as used in most backbones today.

The Unisource subnetwork will connect the following national research networks/organisations:

NORDUnet	(Nordic countries)
SURFnet	(Netherlands)
SWITCH	(Switzerland)
RedIRIS	(Spain)
BELNET	(Belgium)
FCCN	(Portugal)

The Unisource network service offered will not be a static network. Unisource will move the network over to an ATM platform. The first step foreseen in progressing the network to an ATM platform is to move the 'trunk' part of the Unisource network to an ATM-based platform. In order to avoid a degradation of the initially offered service, the trunk connections in the ATM network will be implemented using STM-1 (approx. 155 Mbit/s) circuits. This phase of the ATM transition of this network will be transparent to the connected networks, as the setup at the customer site will remain unchanged. Only in later stages will it be possible to extend the ATM network service to the customer's premises, and in that case Unisource provides both an IP network service and an ATM service. In general, the setup between the trunk router and the ATM switch installed in the Unisource PoPs will be implemented using STM-1/ATM.

Interconnection of the ATM VP subnetwork and the Unisource network

IP routers from both subnetworks will interconnect at three locations in Europe: London (UK), Frankfurt (Germany) and Geneva (CH). Various physical technologies will be in use for this, like HSSI or FDDI, but the speed of the interconnection will be at least 34 Mbit/s (E3). Both routers do not need to be present in one physical location; an E3 leased line might be used to interconnect the two routers.

Management of the TEN-34 network

There will be one Network Management Service which will integrate the two TEN-34 subnetworks and provide a single integrated service for the entire TEN-34 community.
This Network Management Coordinating Entity (NMCE) will be responsible for the monitoring of the network infrastructure and applications, software and hardware maintenance, a trouble ticket system, network security and service reports.

For more information:

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Christoph Graf <Christoph.Graf@dante.org.uk>
TF-TEN web page: http://www.dante.net/ten-34/tf-ten
TEN-34 web page: http://www.dante.net/ten-34

TEN-34 TF-TEN: Testing of advanced ATM technology

Most production ATM backbone networks only make use of conservative ATM traffic classes such as CBR or VBR, avoiding the difficulties of more complex ATM services. In Europe the TEN-34* project aims at providing more advanced ATM services on a pan-European scale. Experiments will be carried out to evaluate the applicability of advanced ATM services such as SVCs and NHRP in an international backbone environment. This is the second element of the TEN-34 Project.

The tests are defined and carried out by TEN-34 under auspices of the TERENA Task Force TEN (TF-TEN), using the pan-European JAMES ATM backbone. TF-TEN initially defined eleven mostly independent experiments to test the operational feasibility of these technologies on a production network.

These experiments include:

1. TCP/UDP over high-speed and long delay: mainly a verification of existing results.
2. SVC testing: applicability of switching in the WAN and related problems.
3. ARP testing: using ARP servers in a WAN environment.
4. NHRP testing: test implementations of the NHRP protocol.
5. Addressing Issues: address translation between E.164 and NSAP addressing.
6. Network Management: specific NM issues with regard to interfacing public ATM networks.
7. CDV Tests: determine the effect of CDV and BT when crossing several independent ATM networks.
8. Native ATM Performance: performance of applications that do not use TCP/IP, but directly ATM
9. IP over VBR: optimisation of parameters.
10. RSVP: to experiment on alternative resource reservation mechanisms and describe differences to ATM mechanisms.
11. Security: investigate security problems in relation to switching

All experiments are carried out over the European JAMES ATM network, and involve most of the European national research networks. Further tests of more advanced ATM service classes such as ABR and interfaces such as P-NNI are planned as soon as these become available.

* TEN-34 is co-funded by the European Commission (Telematics/ESPRIT) under the 4th Framework Programme.

For more information:

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TEN-34 web page:	http://www.dante.net/ten-34

Annex 5: International press contacts (used by DANTE)

Belgium

Lode Goukens - freelance journalist
Luc Van Aelst - Financieel Ekonomische Tijd

Finland

Mr Jarmo Lahti

France

Jennifer L. Schenker - Wall Street Journal /freelance
Rémi Scavénius - ATM Perspectives
Kenneth Hart - Communications Week International
Douglas Lavin - Wall Street Journal

Germany

Gudrun Kosche - Markt&Technik

Netherlands

Henk Engelenburg - Automatisering Gids

Sweden

Lennart Pettersson - Data Communications Datateknik

Switzerland

Peter Boswell - Europhysics News
Valerie Thompson - BYTE/freelance

United Kingdom

Peter Heywood - Data Communications International
Freddie Dawkins - EEMA Managing Editor Media Training
Lorcan Dempsey - University of Bath UK Office for Libr. Netw.
John W. Lilley - Dataquest Europe
Richard L. Hudson - The Wall Street Journal
Jack Schofield - The Guardian - Online
Graham Finnie - Communications Week International
Michael Neubarth - Internet World
Iain Burley - The Write Technology
Richard Poynder - Information World Review Learned Information Europe
Azeem Azhar - The Economist
Christopher Anderson - The Economist
Martin Pipe - freelance
Niall McKay - IDG News Service
Andrew Cray - Data Communications International
David Bowen - Independent Network - Mondays
OSCO (Oxford Scholarly Communications)

United States of America

Ole J Jacobsen - ConneXions, The Interoperability Report
Tim Beardsley - Scientific American
Wendy Rickard Bollentin - OnTheInternet Magazine
John S. Quarterman - Matrix News and Matrix Maps Quarterly, Information and Directory Services, Inc.

Annex 6: press releases

TEN-34 Consortium: towards a real Superhighway for European Research

16 May 1995

A Consortium of eighteen European research and university networking organisations has submitted a proposal with the name TEN-34 in response to the joint call for proposals issued by DG III and DG XIII of the European Commission under the Fourth Framework Programme; a compatible proposal was also submitted under the ACTS programme. The Commission had invited organisations to collaborate in the preparation of bids to establish the interconnection of European research and university networks at 34-155 Mbps supported in part by EU funding. DANTE acts as the co-ordinating body in the Consortium, providing the main technical and financial management as well as assistance to the TEN-34 Steering Committee with the preparation of plans and proposals. A number of public network operators have agreed to be Associated Partners in the TEN-34 proposal.

The main technical goal of the TEN-34 Consortium is to establish and maintain a leading-edge backbone designed to interconnect the National Networks. This will create early opportunities for the research and university community to establish new pan-European networking applications based on new technology.

The initial aim is the provision of a 34Mbps IP infrastructure, and the establishment on a pan-European scale of an ATM-based test network with a clear production service specification in mind. The network will expand to include 155 Mbps technology and higher bandwidths to maintain a leading-edge capability when required and feasible.

In order to establish advanced facilities, special arrangements are being sought with the suppliers of international communication links. This involves the negotiation of special rates as part of a collaborative R&D activity which in turn may require constraints to be placed on usage, and other special measures.

The network is being developed in a pragmatic fashion, meaning that links, nodes and interconnection points are created not only to satisfy, as well as possible, national network requirements, but also as practically and financially feasible. The requirement for intercontinental, specifically transatlantic, connections employing similar technology is also being addressed.

The proposal presents a phased plan to include initially those national research networks which already have high speed networking requirements, for which international links are available and which have sufficient co-funding; other National Networks will join as and when they meet these criteria.

The TEN-34 proposal to the DG III and DG XIII Programme has received a favourable evaluation report and the Consortium is now working to define a detailed implementation plan with those PNOs which have declared their intention to cooperate.

For more information etc.

EC Contract for TEN-34 Breakthrough in European Networking

17 May 1996

The European Commission has awarded a 12 MECU contract under the Fourth Framework Programme to the TEN-34 Consortium, a grouping of national research networks in Europe networks with major European telecoms operators as Associated Partners. Under the contract the first Europe-wide high speed (34 Mbps) computer network for the research community will be implemented. This will match the capacities now being enjoyed by the North American research community, and will provide the first comprehensive international interconnections at high bandwidth.

A number of national university networks, e.g. SuperJANET in the UK, already have a high speed national network infrastructure, which enables researchers to use sophisticated multimedia applications over the network. On an international level these connections are not yet in place. Now the funds and the organisational structure are available to complement national high speed networks with a European interconnect facility.

"The project is a significant achievement for co-operation not only between the European national research networks who have worked closely together over the last year, but also achieves a new level of collaboration between them and major European telecoms operators", said David Hartley, chairman of the TEN-34 Steering Group.

In March 1995 eighteen national research networks, which interconnect universities and research organisations at a national level, submitted a proposal in response to the combined Telematics for Research/ESPRIT Call for Proposals. TEN-34 stands for: Trans-European Network Interconnect at 34 Mbps.

The plan for the facility is as follows: France Telecom, BT, Deutsche Telekom and Telecom Italia will set up a data-transmission sub network based on ATM Virtual Paths, to be known as ABS (ATM Broadband Services), between France, the UK, Germany and Italy offering 34 Mbps aggregated access capacity. Unisource will set up a managed 34 Mbps service between the Unisource home countries (Sweden, Netherlands, Switzerland, Spain). Countries outside the two groups will decide which of the two subgroups they will join. Unisource and ABS have agreed to provide interconnection between their two networks at at least two points in Europe. The National Research Networks in the TEN-34 Consortium plan to provide an integrated pan-European Networking Service offering IP.

In addition TEN-34 have agreed with the JAMES Consortium (consisting of the European telecoms operators) on the use of an ATM test network required for validating ATM based services (the second element of the TEN-34 proposal). This will enable the experience of the research community to contribute to the development of new multi-service technologies in a pan-European context, bringing them sooner to full service status.

Full Partners from the following countries in the Consortium have signed the contract: Austria, France, Germany, Greece, Italy, Luxembourg, the Netherlands, NORDUnet (on behalf of Denmark, Finland, Norway and Sweden), Portugal, Spain, Switzerland, the UK and DANTE, as Coordinating Partner. A complete overview of the involvement of all partners is also available.

DANTE submitted a detailed proposal for the Technical Annex of the contract. The TEN-34 proposal provides for refinement of the Technical Specification during the first few months of the Project. An important part of this work will be the definition of an objective set of acceptance criteria which will ensure that the new service will offer acceptable Quality of Service and value for money. There will also be the opportunity for other National Research Networks and Telecoms Operators to join in before the first implementation starts.

DANTE is a not-for-profit company with research association status in Cambridge which is owned and was set up by a number of national research networks (one of which UKERNA) to organise and manage advanced network services for the research community at a European

For more information etc.

Annex 7: Pointers to TEN-34information provided at a nationa level

DFN - Germany
DFN Mitteilungen, 3/96, Erfolg für Ten-34 - Europaweites Breitband-Netz wird realisiert
URL: http://rtb-www.rrzn.uni-hannover.de:80/dfn/mitteilungen/html/heft40/G15/G15.html

RENATER - France
Web link: http://www.urec.fr/Renater/renater2/autorouteseurope.html

GARR - Italy
Web link: http://www.garr.net/

GR-NET - Greece
Web link: http://www.grnet.gr/index_en.html

NORDUNET - Nordic countries
Web link: http://www.nordu.net/news/news.htm#triangle

RedIRIS - Spain
Newsletter RedIRIS Boletin, No 35,
URL: http://www.rediris.es/rediris/boletin/35/actualidad.html# TEN-34

SURFnet - The Netherlands
SURFnet projects page, URL:http://www.nic.surfnet.nl/surfnet/projects/

Mentioned in SURFnet Guide 96/97:
URL:http://www.surfnet.nl/surfnet/gids/hfstk2-2.html

Mentioned in Annual Reports
URL: http://www.surfnet.nl/surfnet/publ/jaarverslag/1995/

Mentioned on SURFnet4 WWW-pages
URL: http://www.nic.surfnet.nl/surfnet/projects/atm/sn4fr0-2/surfnet4-3.html

The Works of DANTE is disseminated among SURFnet employees, sometime items are included in Netnieuw, SURFnet's elecronic news bulletin.

SWITCH - Switzerland
Article on TEN-34: SWITCHjournal 2/96, to be published on December 18, 1996.

Web link: http://www.switch.ch/switch/About.html

UKERNA - United Kingdom
Regular updates on TEN-34 have appeared in UKERNA's newsletter throughout the life of the project, and a review article on its present status is scheduled for publication in the next edition.

When giving presentations to the UK HE community, which is done frequently, TEN-34 is mentioned whenever we review the status of international connections with JANET.

As Chairman of the Consortium David Harley has given a number of presentations on TEN-34, see Annex 3 .

Web links: http://www.ja.net/documents/NetworkNews/Issue44/contents.html
http://www.ukerna.ac.uk/UKNationalHost/news/acts-news/acts-news.html