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TEN-34 and JAMES: Technical Plans

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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.

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) 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-

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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.

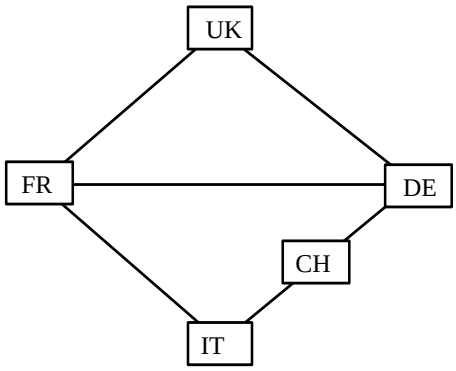

figure 1: Planned FUDI topology; the boxes are ATM switches.

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.

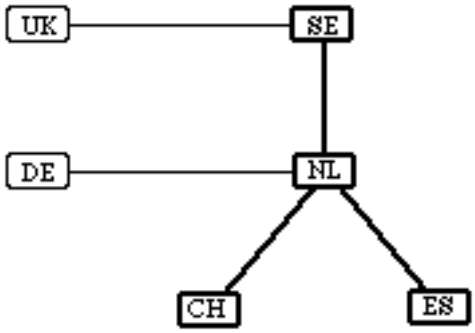

figure 2: Planned Unisource topology; the boxes represent routers; the bold parts show the Unisource main countries.

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.

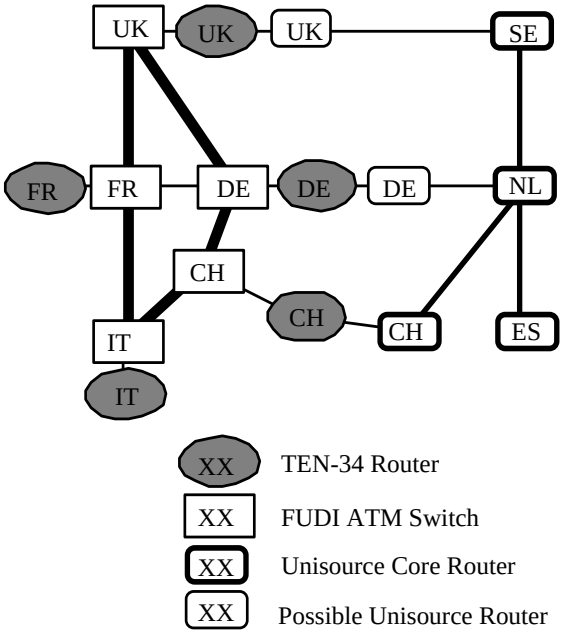

figure 3: Planned TEN-34 topology

II.D. Planned Topology

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

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.

III.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.

III.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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Author Information

Michael H. Behringer holds the position of Senior Network Engineer at DANTE. His responsibilities include the planning and development of network services on EuropaNET and on the TEN-34 high-speed networks. In the TEN-34 project he is specifically responsible for the cooperation with JAMES on testing ATM backbone facilities.