#38

Pan-European Research Networking in a Liberalising Environment

Dai Davies

This paper will be presented by Dai Davies at the "IP Networks - Internet, Intranet and Extranet" Conference in Ljubljana, Slovenia on 24-25 May, 1999.

DANTE IN PRINT is a track record of papers and articles published by, or on behalf of DANTE. HTML and Postscript versions are available from: http: / / www.dante.net / pubs / dip

For more information about DANTE or *DANTE IN PRINT* please contact:

DANTE
Francis House
112 Hills Road
Cambridge CB2 1PQ
United Kingdom

Tel: +44 1223 302992
Fax: +44 1223 303005
E-mail: dante@dante.org.uk

Pan-European Research Networking in a Liberalising Environment

Dai Davies

1. Introduction

Research networking has been responsible for many significant developments in telecommunications in the last twenty years, most notably the Internet. This innovative approach has been achieved by ensuring that researchers have had access to telecommunications services and facilities in advance of their availability to the general market place. Most of these developments have taken place in North America where the telecommunications market was liberalised at the beginning of the 1980s. In contrast, due to its historically regulated and monopolistic market in telecommunications, which had been in fact a set of disparate national markets, Europe has been unable to match the United States.

Bandwidth in Europe which crosses national borders has always been expensive and rationed, thus European researchers have never had the pan-European network to enable them to develop innovative products. This has had two effects. Firstly, there has been relatively little European focussed Internet development and, secondly, there has been a significant European contribution to American efforts which has been at the centre of American commercial success in this technology.

On the 1st January 1998, things started to change within Europe as the liberalisation of the telecommunications markets actually started to take effect.

This paper examines the result of that liberalisation as it has affected the development of the pan-European research network known as TEN-155. Figure 1 illustrates the current TEN-155 topology. TEN-155 has tracked and built on the successes and failures of European liberalisation. The ability to be able to build a true pan-European research network raises a number of important policy issues in respect of usage and future strategy which are also addressed.

Dai Davies is DANTE's General Manager. Dai's email address is Dai.Davies@dante.org.uk .

2. The Economics of pan-European Networking

Historically, it has been the case that a cross border circuit between two adjacent European countries would be of a similar price to that for connecting either of the countries to the USA. This fact has been spuriously used to argue that an appropriate topology for a pan-European network would be a US East Coast based star structure taking advantage of economics in the USA. In fact, such a solution would be more expensive than a properly designed pan-European network. Nevertheless, it illustrates just what the historic costs of pan-European networking were.

As a result of this unrealistic pricing for international circuits within Europe, research networking has been slow to develop on a pan-European basis and has been seriously constrained in capacity terms. Over the last ten years, the capacity of the pan-European network has increased from 64 KBps to 155 MBps. A comparison with the USA over the same period would show a growth for 45 MBps to 2 GBps. Most of this European progress has, in fact, been made in the last year. Until the introduction of TEN-155, changes have been relatively slow and, as a

whole, the international market for telecommunications in Europe has been relatively homogenous and very expensive.

The procurement organised by DANTE for TEN-155 represented the first major breakthrough in the acquisition of bandwidth at prices that bore some practical relationship to underlying costs. Overall, the network represented a factor of 6 improvement in bandwidth costs. This simple average, however, hides a very significant variation in the effectiveness of the liberalisation of the international market for telecommunications within Europe. TEN-155 was organised with a public call for tender and DANTE received over 100 offers for connectivity. A summary analysis of the tender offers is presented in Table 1 which shows the variation in prices offered. It is apparent that there are three distinct groups of countries in Europe when it comes to progress in liberalisation. Based on the results of the tender for TEN-155, it is apparent that the Group A countries represent a reduction in cost of a factor of 10 when compared with 1997 prices (see Table 2), whereas for all the Group B countries the factor is 4 and for Group C the factor is 3.5. Portugal was the only country where the offers received for TEN-155 were actually more expensive than was the case for its predecessor network.

A further point is the availability of "relatively" high capacity connectivity. Capacity of
155 MBps is only available in the Group A and some Group B countries. Thus there are still significant parts of Europe where infrastructure is both expensive and rationed. It is not clear whether this is caused by lack of infrastructure, or by fear of competition. The latter is the more probable explanation.

The liberalisation of the market place, although quite impressive in aggregate, is really relatively fragmented in practice and the experience of TEN-155 shows the substance

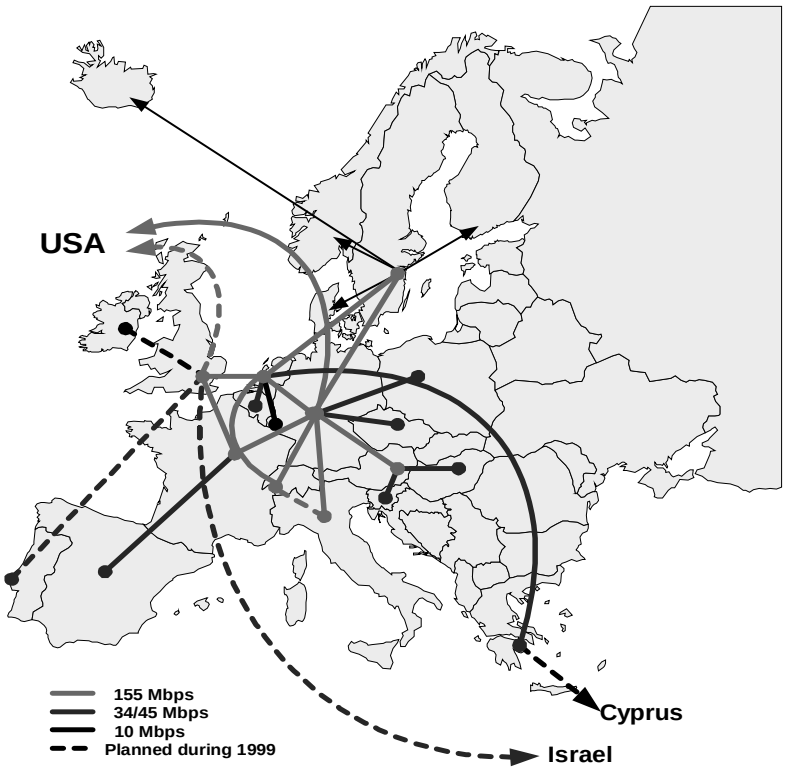

Fig. 1 TEN-155 topology April 1999

of a "3 speed Europe" when it comes to research networking. The relatively homogeneous cost base of two years ago (see Table 2) has given place to a quite heterogeneous picture. As a consequence, DANTE has had to abandon the geographically independent pricing scale based purely on access capacity. Thus countries where international telecommunications is relatively expensive are disadvantaged compared to those where prices are relatively cheap. The purpose of a pan-European research network must be to encourage co-operation among European researchers for the general benefit of European society both in terms of scientific and technical knowledge, as well as for social advantages. Liberalisation has had the divisive effect of making more capacity available but only in certain parts of Europe. As a consequence, the current results of liberalisation are a tendency to fragment what ought to be a concerted European effort to improve research infrastructure everywhere.

We have seen a significant reduction in Bandwidth prices in certain parts of Europe. Indications are that prices in the more competitive parts of Europe will continue to fall faster than in other parts of Europe. Certainly, this looks like being the case for the next two to four years, thus the differential cost on connectivity between cheaper and more expensive countries will continue to grow. Although European liberalisation formally started in 1998 and should be completed by 2001, the monopoly culture remains strong in many European incumbent operators. This will continue to inhibit the development of the market. The major issue for the future is the way that European research co-operation preserves its cohesion in an environment where underlying cost structures are encouraging breaking up the network.

The results to date have shown the real success of liberalisation in delivering better, cheaper and faster service, however, in order to assist European cohesion much work needs to be done to ensure that all European countries enjoy the benefits of liberalisation.

Table 1 : Summary of Tender Offers (All Figures K EURO's / Mbps / Year)

Speed Mbp / s	155	45	34	10
Germany Switzerland The Netherlands UK Nordics France Ireland	Group A			
Mean	14.7	18.4	22.5	28.4
Luxembourg Belgium Austria Italy Spain	Group B			
Mean	34.3	54.1	–	–
Slovenia Czech Republic Hungary Greece	Group C			
Mean	–	–	59.82	–
Portugal	–	–	–	–

Table 2 : Pan-European Research Network Price Evolution

	Average Price	Max Capacity
1996 EuropaNET	200 K EURO / Mbt / yr	2 MBps
1997 TEN-34	150 K EURO / Mbt / yr	34 MBps
1998 QUANTUM	30 K EURO / Mbt / yr	155 MBps

3. Research Networking and the Internet

The Internet is a very widely used but very vague term. It can be regarded as a description of technology, a description of a network or, indeed, a description of some "sort of" end to end service. The recent introduction of the term Intranet has helped to clarify the difference between private networks and public networks. Nevertheless, the term Internet has a very general meaning but is difficult to use precisely.

It is interesting to look at the history of the development of the Internet. Its origins date from research sponsored by the US Department of Defence, but the first practical and significant Internet was the National Science Foundation Network (NSFNet) in the USA. The essential purpose of NSFNet was to provide connectivity between the different University and Research institutions in the USA. It was successful and proved extremely popular. Although NSFNet was implemented with government funding for research and education connectivity, it had a very significant commercial weakness in as much as it allowed or, probably more accurately stated, did not prevent the reselling of capacity to the commercial world at large. As a consequence, what was originally set up as a facility for research and education became increasingly diluted and commercial competition to it started to emerge.

This commercial competition challenged the reselling of NSFNet and the National Science Foundation, in response to this criticism, promptly declared the project to have been successful and closed down the network in 1995.

NSFNet was replaced with a much more limited, high performance, network known as vBNS. vBNS provides very limited connectivity to the research and education community in the USA. Grass roots pressure has led to the recent establishment of a new organisation (the University Corporation for Advanced Internet Development, UCAID). UCAID is currently establishing a much more comprehensive research and education network in the US. An important factor of both vBNS and the UCAID initiative is that they have separated commercial Internet traffic (sometimes described as commodity Internet) from communications which are limited to the research and education community. There is, therefore, no ambiguity about the purpose of the network and objections from the commercial world about its policy objectives will be much less effective.

The issue of commercial traffic and its relationship with research and education traffic is an important one. The history of the Internet has created much confusion. In the early days, the Internet was constructed from facilities where the user of the facility was typically different from the organisation paying for the facility. This led to an anarchistic commercial development and some fairly chaotic understanding of the economies of telecommunications networks. The result is the naive assumption that the Internet is about free connectivity for all. This remains a potent, all be it incorrect, perspective of network economics.

In practice, the Internet in the USA has changed from being a co-operative activity, where others were paying the bill, to a very serious commercial interest. As far as Europe is concerned, we are several years behind in this commercial development. The happy anarchy which prevailed in the early 1990s in the USA is something that, to some reasonable extent, exists in Europe today. This gives rise to serious issues that need to be considered, particularly in an environment of market liberalisation. There is the question of the relationship between research and education communications and their connection with the commercial Internet. Also, there is the question as to the justification for a separate network to support pan-European research and education. These and other policy questions are discussed in paragraph 4.

4. The Policy Implications for pan-European Research Networking

There are a number of major policy issues that emerge from the liberalisation of the European market in telecommunications as it affects the development of pan-European research networking, notably:-

Three Speed Liberalisation

The variation in the range of liberalisation across Europe has had a significant effect on the cost structures that are experienced in building a pan-European network. The net result of this is that costs for links in the cheaper countries are less than half those in the more expensive countries and less than a quarter of those in the most expensive countries. This gives rise to an important policy point. One of the purposes of a research network is to encourage co-operation on a pan-European basis. If certain countries are disadvantaged, then the "centripetal" effect of the network will be undermined. It is important that ways are found to ensure that countries in more expensive locations are not penalised by the current state of the market.

As a corollary to this, the tender proposal for TEN-155 has given a very clear insight into the state of liberalisation of international telecommunications in Europe. The picture is only one of partial success. Certainly, liberalisation has made a significant difference in some countries. The current state of liberalisations, however, actually works as a deterrent to the creation of truly pan-European networks. The political challenge remains to enable all European researchers to have access to infrastructure at realistic prices.

Relationship with the Commercial Internet

There is some level of demand for pan-European connection between research networks and commercial Internet users. The policy issue that arises from this is the way such interconnection should be organised. Fortunately for Europe, a clear example of how not to organise things has recently been demonstrated in the USA. The vacuum that resulted from the closure of NSFNet demonstrated conclusively that research and education needs its own networking infrastructure if it is to carry out the sort of work that requires capacities and services that are not available from the general market place. Service suppliers will argue that the market will satisfy all needs. US experience proves this to be a false assumption. In order to provide a lasting solution the issue of commodity Internet connectivity needs to be solved. The more recent developments in the US have been somewhat more practical and realistic. The Internet 2 initiative is again creating a dedicated research infrastructure and they are today separating out, at the access to the US backbone, commodity IP traffic from research traffic. This is sensible. Commercial Internet traffic is a commodity item in the USA today and is becoming so in Europe. Thus, it is possible to share an access for research and commodity traffic but commodity traffic travels over the commercial Internet infrastructure.

Hardware & Bandwidth Costs

It is apparent that the market which is developing has not yet reached the level at which prices bear a relationship to costs. There is much more scope in the development of transmission technology and it is reasonable to predict that, in two years time, the most competitive prices for bandwidth will be a small fraction of the prices charged today. This is, in principle, good for the research networking community in Europe but it does highlight a number of issues which have not, until now, been important. Most particularly, the significant reductions in connectivity prices illustrates the relative expensiveness of the router and switch hardware that is being used. Three years ago the hardware cost was a trivial part of the overall network cost. Now it is becoming a very significant one in its own right and we need to look very seriously at the purchasing of expensive American boxes to support European co-operative research and development.

Provision of Quality Service

Another important factor is one of quality of service. Quality has always been an issue in pan-European research networking. There has never been an opportunity to guarantee Quality of Service, mainly due to the lack of available bandwidth. With TEN-155, this changed and the Managed Bandwidth Service (MBS), currently being piloted in TEN-155, has shown that it is possible to offer guaranteed Quality of Service on an end to end basis. There is a simplistic view that the answer to Quality of Service is merely to throw bandwidth at the problem. In a network where budget is unconstrained and end-to-end management is in the hands of a single organisation, this is a practical solution. In the real world, however, the question of Quality of Service remains unanswered. The research network community needs to find some good answers to this question which apply right across Europe. It is trivial for a single network to do this. For a simple co-operation among twenty networks, combinatorial arithmetic tells you that there are 190 potential solutions. We need one solution for Europe.

Research Into IT and IT Research

The absence of access to high speed infrastructure in Europe during the last ten years has meant that there has been little "pan-European networked" research and development in IT. This has been caused by the monopoly PNOs. There was some co-operation between the monopoly PNOs and their traditional hardware suppliers. There was virtually no co-operation with the Research networking community. As a consequence, the research networking community has, in general, focused on co-operation with the USA where the technical challenges of Internet development existed. The liberalisation of the European market creates a new opportunity for co-operative European R&D in telecommunications and IT.

In order to achieve this, it is important to develop precise policy goals. There is a danger that R&D will remain compartmentalised and the current fragmentation will be carried on into the new liberalised environment. In order to avoid this, it is important to recognise that there is a spectrum of networked IT research and development which ranges from laboratory based activities to use of a network for the development of networking technology and application. It is vital that the Wide Area Networking requirements involved in such R&D will be treated as a unified pan-European activity. Fragmentation of infrastructure does not help. The test programme organised under the Quantum Project, with DANTE as co-ordinating partner, illustrates what can be achieved by co-operation between service providers, vendors of hardware and the research networking community. This should be the model for future co-operation.

5. Conclusions

- In general, liberalisation of telecommunications within Europe has led to a real breakthrough in the costs of pan-European research networking. This overall success of liberalisation, however, masks very variable progress within Europe.

- There are, today, much bigger cost differentials between the cheaper and the more expensive countries in Europe. This discourages the creation of a true pan-European Research Network.

- In order to make the benefits of liberalisation "Europe wide" political action is required to enforce realistic cost based pricing of telecommunications across Europe.

- European research networking must learn from US mistakes and experience in its relationships with the Commercial Internet Service Provider.

- Quality of Service poses the biggest unsolved technical challenge.

- There is a unique opportunity to develop a pan-European research network based on TEN-155 and create a single pan-European infrastructure which can form a development platform for research and co-operative R&D.