Intercontinental Connectivity Developments as reported in The Works of DANTE 1993-1997

December 1993

EuropaNET: a combination of pan-European backbone services up speeds of 2 Mbps, gateways to other (European) networks and intercontinental connectivity to the US.

A 2 Mbps transatlantic link has been ordered between Amsterdam and the Washington GIX; DANTE will provide US connectivity to networks such as ARIADNET (Greece) and RedIRIS (Spain) as well as SURFnet (Netherlands) which do not have direct access to a transatlantic link of their own. SWITCH (Switzerland) has agreed to purchase its US connectivity - as well as an increase in capacity for its European traffic - via DANTE and CERN (Geneva) has decided to acquire 1024 kbps of global connectivity from EuropaNET. In order to support US traffic from CERN and SWITCH, DANTE is acquiring a second transatlantic line, at T1 speed (1536 kbps), between Washington and the CERN site. A number of High Energy Physics communities are planning to communicate with CERN via EuropaNET, with the hope that the performance they obtain will allow them to suppress their private leased lines; American physicists who need to access CERN facilities will also be encouraged to make use of the EuropaNET access path.

DANTE has also been asked by the CEC to make 64 kbps connections to EuropaNET from Canada and from Korea. Initial preparations have already been made; the connections will be finalised once formal contracts are in place.

February 1994 - News from the Intercontinental "Front"

A contract for the provision of a 64 kbps line between EuropaNET and KREONET, the Korean research network, has been signed between DANTE and the CEC (DG-XIII). The line will be the first direct link between EU countries and an R&D network in the Pacific Rim. The aim is to stimulate the - so far - relatively weak co-operation between European and Korean researchers.

The 1.5 Mbps link between Geneva and Washington has been operational since 1 January. The 2 Mbps line between Amsterdam and Washington has been declared operational by PTT Telecom; connection to the Washington GIX is imminent.

DANTE's EuropaNET access point in Amsterdam provides a route for traffic between countries such as Spain and DANTE's US circuit as well as forming the DANTE half of the EMPB/Ebone interconnection. This access has been running at 2 Mbps since 12 January. The daily peak traffic regularly reaches 1.3 Mbps (average over the busiest 15 minutes period).

April 1994

The 2 Mbps line between Amsterdam and Washington (finally) came into operation on 17 March 1994. Dai Davies, DANTE general manager, commented: "This was an unusually challenging activity and the effort required from DANTE to do so is a sad reflection on the difficulties that still exist in getting international line providers to organise simple things." The line was ordered in November 1993 and was originally planned to be operational by January 1994.

June 1994 - MAJOR INCREASE IN EUROPANET CONNECTIVITY TO THE US

DANTE will expand its existing connectivity to the US from 3,5 to 10 Mbps. The capacity increase will be used to support traffic growth as a result of the deployment of high speed networks in some European countries, in particular The Netherlands. The increase involves implementing a 8 Mbps line between Amsterdam and Washington.

This line will constitute the largest link between the US and the European part of the Internet research backbone. SURFnet, the Dutch national research network, will be the first customer to benefit from the 8 Mbps intercontinental connectivity.

Boudewijn Nederkoorn, Managing Director of SURFnet, said: "We need this capacity increase to meet our short term bandwidth requirements. We are in the process of setting up an ATM backbone in the Netherlands of nine 34 Mbps connections, and the traffic growth to the US simply demands more capacity than 2 Mbps." SURFnet will be by far the biggest single customer for intercontinental connectivity, but the benefits from the capacity increase will serve researchers on both sides of the Atlantic.

DANTE has already started negotiations with possible line suppliers and expects to have the line in place by October 1994.

THE KOREAN CONNECTION

A contract for the provision of a 64 kbps line between EuropaNET and KREONET, the Korean research network, was signed between DANTE and the CEC in February 1994. The circuit has now been ordered and should be operational within a few months. It will be the first direct link between the European research community and an R&D network in the Pacific Rim. So far cooperation between European and Korean researchers has been relatively weak.

August 1994 - US CONNECTIVITY ISSUES

DANTE will locate the US end of its new 8 Mbps link from Amsterdam to the US at the Network Access Point (NAP) in New York which is set up as a result of the new arrangements which have been put in place by NSF. Another consequence of NSF's changes is that trans-(US-)continental broadband network is not available for general use. As a consequence, DANTE and other non-US organisations will have to make new arrangements with US service providers for distribution of their traffic with the US and for transit between Europe and Asia/Pacific (see also 'Some impressions from the 30th IETF').

The actual form of the NAP connection still has to be decided on: the choice will be either to obtain a direct connection or via a US service provider.

CONNECTION TO KOREA IN PLACE

A 64 kbps line between Europe and Korea has become operational on 23 August 1994. The line provides a direct link between KREONet (Korea Research Environment Open Network), the Korean national R&D network and EuropaNET. DANTE was awarded the contract to organise the connection under the EC EKORN project.

KREONet, one of five government networks in Korea, was launched in 1988 and connects all the major university, government and commercial research institutes. It provides the Korean research community with the 'usual' services such as e-mail, file transfer, remote login etc. DANTE's partner in setting up the connection has been SERI (Systems Engineering Research Institute), the organisation that operates, manages and develops KREONet.

October 1994 - US CONNECTIVITY ISSUES

Because of new arrangements that are being put in place by NSF at the moment, DANTE and other non-US organisations have to make arrangements with US service providers for distribution of traffic with the US and for transit between Europe and Asia/Pacific. DANTE has now decided to connect EuropaNET to the New York Network Access Point (NAP) via a US service provider.

In June DANTE announced its plans to extend EuropaNET intercontinental connectivity with an 8 Mbps line between Amsterdam and the US. This extra connectivity will consist initially of an extra 2 Mbps line, which will be augmented by more 2 Mbps lines as they are needed. The company is currently working hard to get the connection, which eventually will consist of up to four 2 Mbps lines, in place by mid November. The circuit has been organised as a result of the increased intercontinental connectivity requirements of in particular the Netherlands, although DANTE's other customers will benefit from it as well.

January 1995 - TRANSATLANTIC CONNECTIVITY INCREASING

The first circuits as part of the plans to upgrade EuropaNET connectivity from Europe to the US have been acquired. A new T1 (1.5 Mbps) line between Amsterdam and New York became operational in December 1994. This brings the total capacity of EuropaNET's US connectivity to 5 Mbps. The order for the second T1 link from Amsterdam has been placed and the link is expected to be in place by February.

At the request of SURFnet and DFN, DANTE will manage a direct link between Germany and the Netherlands. One use of this additional capacity will be for traffic between the Dutch and the German Aviation and Space Research institutes. For this purpose DANTE will set up a Point of Presence (PoP) in Aachen, Germany. In addition DFN has decided to obtain additional intercontinental connectivity from DANTE which can be delivered via Amsterdam and this new German-Dutch link. A further T1 circuit will be ordered to provide the extra capacity needed. To improve the US service for other EuropaNET subscribers ways of upgrading the capacity of the DANTE gateway in Amsterdam (which provides them with US access) are being discussed with Unisource.

DANTE has started work under a contract with the European Commission to set up a connection between EuropaNET and Canada. The first phase of the work will be to assess what sort of capacity is needed and how it can best be organised. A recommendation will follow on which the actual implementation plan will be based.

May 1995 - EUROPANET UPGRADES

The DANTE gateway in Amsterdam, which provides customers with US access and connectivity to Ebone, was upgraded from 2 to 4 Mbps at the end of April. In addition further T1 circuit between Amsterdam and the US came into operation in mid-March, bringing the total capacity of EuropaNET transatlantic connectivity to 6.5 Mbps.

September 1995 - TRANSATLANTIC CAPACITY INCREASES

Two T-1 (1.5 Mbps) circuits have been ordered by DANTE for connection to the BT Points of Presence (PoP) in London and Amsterdam. Four additional T-1 circuits have been ordered for connection to the DANTE PoP at SARA. This will give DANTE a total of 6 T-1s (9 Mbps) to the US from the DANTE PoP in Amsterdam, bringing DANTE's total transatlantic capacity to 12 Mbps. The existing E-1 (2 Mbps) from Amsterdam and T-1 from Geneva will probably be cancelled once the new links are in place. All the T-1s mentioned above are connected to the ANS service in New York. Both of the BT-connected lines have been delivered but are not yet tested at the IP level; the remaining circuits are planned to start operating in the first week of October.

December 1995 - INTERCONTINENTAL CONNECTIVITY: CURRENT STATUS

DANTE currently has 14 Mbps connectivity in place between Europe and the US. There are five T1's between ANS in New York and Amsterdam (7.5 Mbps) dedicated for SURFnet. One more T1 to ANS and one E1 (2 Mbps) to ICM are for the usage of the German, Hungarian, Czech and

Romanian networks. Furthermore there are two T1's directly between ANS and IBDNS. This brings the total capacity for SURFnet to 7.5 Mbps, for DFN, Hungary, Czech Republic and Romania to 3.5 Mbps and for other DANTE customers to 3 Mbps (with a further T1 on order).

February 1996 - TRANSATLANTIC CONNECTIVITY

UKERNA, the UK national network has asked DANTE to organise an extension of their transatlantic capacity with 9 Mbps. DANTE will organise the provision of six T1s (1.5 Mbps) to provide the requested additional connectivity, which will bring its total transatlantic capacity to 24,5 Mbps. There are additional requests from SWITCH and enquiries from BELNET and DFN for a considerable increase in their US connectivity.

The current position on the co-funding of transatlantic capacity by US research organisations contains a number of fundamental inequities. Whilst there are winners and losers on this side of the Atlantic there is no doubt that Europe, taken as a whole, pays significantly more than its fair share of the cost of interconnection. When NSFnet was funded as a research network, the National Science Foundation co-funded lines to several European National Research networks. With the commercialisation of the Internet in the USA the future of this co-funding is uncertain. Historically, Europe was a net importer of bits from the USA. However, it is true for lines managed by DANTE, that traffic between Europe and the USA is balanced and this is more generally the case. There is therefore a need to develop a settlement model which fairly relates costs and benefits.

DANTE, in co-operation with a number of its shareholders, has had discussions with US funders and Internet service providers aimed at achieving a much more balanced arrangement. Whilst there is recognition in the USA that the current state of affairs is no longer tenable and there is sympathy towards establishing a fair arrangement, it will require some time to establish this since US researchers are generally accustomed to see this provided as a free part of the Internet.

April 1996 - TRANSATLANTIC CONNECTIVITY

Connectivity between EuropaNET and the US is continuously being upgraded. Currently 12 T1's (18 Mbps) and one E1 (2 Mbps), a total of 20 Mbps, are in place. The latest increase in capacity was organised by DANTE on behalf of UKERNA and SWITCH and we have had further enquiries about increasing the connected capacity. With the purchase of each incremental circuit DANTE and its customers can benefit from greater economies of scale.

The use of T1's as a building block to increasing capacity is attractive since it allows diversity of routing and single failures do not have disastrous consequences. However there are major developments underway in European research networking as a result of national initiatives complemented by the TEN-34 project and the clear need is for European and north American researchers to interconnect at least 45 Mbps and preferably higher speeds.

There is however a major disincentive to this in the lack of US co-funding of the necessary infrastructure. On a conservative estimate European researchers pay at least 80% of the cost of the connectivity with their North American counterparts. There is some co-funded capacity but this organised to connect to specific national research networks within Europe. In view of the relatively balanced traffic loads between the European research Internet and the North American Internet this state of affairs is inequitable. DANTE, along with a number of others, is pressing for a fairer way of sharing costs between Europe and North America.

An approach whereby national research networks collaborate in the establishment of transatlantic connectivity could provide a solution for the inequities that currently exist. By offering US researchers access to a 'greater' European research Internet the case for a better balance in transatlantic funding would be strengthened.

June 1996 - CONNECTIVITY TO JAPAN

DANTE has reached agreement with NACSIS, the Japanese research networking organisation to set up a direct 2 Mbps connection between EuropaNET and Japan. The new connection will give a major improvement in connectivity between researchers in Europe and South-East Asia. The connection is planned to become operational later this summer.

August 1996 - US CONNECTIVITY

The changes as a result of INCS mean a substantial increase in the US connectivity DANTE can offer to its customers. INCS has a 45 Mbps connection to the US to be supplemented with a second US connection at 34 Mbps capacity later this year. 6 Mbps of the 45 Mbps BT/MCI link is now available (shared with other BT customers) to EuropaNET customers. This brings the current total to 26 Mbps. In 1993 DANTE started out with a capacity of 3.5 Mbps. In three year's time nearly an eight-fold increase has been achieved, at an increasing rate of growth (see table below).

December 1993	3.5 Mbps
December 1994	5 Mbps
December 1995	12 Mbps
August 1996	26 Mbps

The requirements of TEN-34, and the growing number of emerging national high capacity research networks will make further substantial increases in US connectivity in the short term necessary.

JAPAN LINK

A new 2 Mbps connection with Japan is established in Amsterdam. NACSIS, the Japanese research network organisation involved, arranges for the connections across the Pacific to the US and from there to Amsterdam. It is the first direct connection between the Japanese research network NACSIS and the European research networks connected to EuropaNET and it will facilitate co-operation between researchers in Europe and Japan. It is a 2 mbps terrestrial connection which is routed via the USA but ensures dedicated bandwidth.

February 1997 - A DANTE POP IN THE US?

When DANTE first started providing Intercontinental connectivity in 1994, it was provided on two shared circuits, a T1 circuit (1.5 Mbps) from Geneva and an E1 (2 Mbps) circuit from Amsterdam. This was shared among a number of customers who used EuropaNET to access the capacity. The arrangement was successful technically as long as the total usage was within the capacity available. It was successful commercially since there were very significant economies of scale in purchasing T1 or E1 capacity, both for the US circuits and for transit within Europe, when compared with slower speeds. Thus a shared facility was of benefit to those who could only afford limited connectivity.

As volumes of traffic grew this approach would not scale, mainly from a commercial point of view. The economies of scale that were available at speeds up to T1/E1 did not exist at higher speeds and the next building block 34/45 Mbps, whilst cheaper per Mbps, were too expensive to justify. The solution was to implement a mixed solution of dedicated and shared capacity based on multiple T1 circuits. There were purchasing economies of scale to be achieved by pooling European procurement of these circuits which were reflected into pricing.

Total intercontinental capacity has continued to grow to the point where a number of networks are now implementing 45 Mbps circuits. European distribution costs are also reducing as a result of the implementation of TEN-34. One cost factor that has however remained stubbornly resistant to

change is the unwillingness of the US Internet service providers to contribute anything to the cost of what are in practice shared facilities with shared benefits.

In order to manage this rapidly changing environment DANTE has been examining the possibility of establishing its own Point of Presence in the USA. The establishment of the Point of Presence would have the advantage of providing a degree of commercial stability and allow a more flexible approach to provision of connectivity as the economics of trans-Atlantic capacity continue to change. It could be available for both dedicated and shared capacity. Currently planning is focused on the location of the PoP and the logistics of implementation. We expect to finalise these within the next few weeks.

April 1997 - DANTE POP IN THE US

As reported in the previous issue of TWoD DANTE is examining the possibility of establishing its own Point(s) of Presence in the USA. The establishment of a Point of Presence would have the advantage of providing a degree of commercial stability and allow a more flexible approach to provision of transatlantic connectivity. Following discussions with a number of US carriers and facility operators this week DANTE now has several options for implementing a 'EuroPOP' in the US. We will be evaluating the pros and cons of the offers and intend to produce a final proposal within a few weeks.

June 1997 - THE TRANSATLANTIC CONNECTIVITY ISSUE

More than three years after first mentioning its plans, the US National Science Foundation (NSF) has issued its solicitation for the establishment of high-performance connectivity between the NSF's very High Speed Backbone Network Service (vBNS) and high performance networks of major international research partners. The solicitation is for a range of global connectivity from the USA and requires a response led by an American organisation but envisages a number of such awards to consortia involving non-US partners. The scope of the solicitation is somewhat limited in terms of financial support and it also envisages a number of restrictions on connectivity both in terms of a requirement to interconnect in Chicago and restrictions on the non-US users who may benefit from co-funding. Nevertheless DANTE is evaluating, co-operatively with interested parties in North America and with the European NRNs the possibility of DANTE being the European partner in a US led consortium.

In the meantime DANTE has submitted plans to the TEN-34 consortium for the addition of intercontinental connectivity to the TEN-34 backbone. A number of commercial offers are currently being evaluated which are likely to lead to the provision of a 34 Mbps or 45 Mbps connection between Frankfurt and the USA. The service will be available as a separate offering from DANTE to those countries who are currently using shared capacity or would like to take advantage of sharing a high capacity circuit.

August 1997 - RESPONSE TO NSF SOLICITATION

On behalf of the European NRNs and as part of a consortium led by the University of Illinois at Chicago (UIC), DANTE has responded to the NSF Solicitation for the establishment of high-performance connectivity between the NSF's very High Speed Backbone Network Service (vBNS) and high performance networks of major international research partners.

In the response DANTE and its UIC partner have tried to address and overcome the dissimilarities between the US and the European research networking situations. Whereas the NSF funds a high speed research network (vBNS) which connects a limited number of approved research organisations, the European National Research Networks offer a backbone linking their entire R&D communities. In addition there is a pan-European network, TEN-34, which connects the National Research Networks together. Also the NSF solicitation limits itself to connectivity for one particular type of research collaboration: into advanced research applications.

In total European Research Networks spend currently around 40 Million dollars per year on connectivity between Europe and the US, which covers in excess of 90% of the total costs. With a total budget of 5 Million dollars per year for all of its intercontinental connectivity the NSF solicitation goes some limited way to redressing this imbalance but the need remains for an equable cost sharing approach to connectivity with US Internet service providers, who provide the bulk of connectivity to the US research community. With increasing capacities the demand for a fair solution is becoming more urgent.

October 1997 - NEW DANTE PoP IN THE US

DANTE has placed a contract for a transatlantic service consisting of a 34 Mbps link from TEN-34 in Frankfurt to New York (upgradeable to 45 Mbps), a DANTE PoP in New York, an interconnection to Teleglobe's Internet service, and a 45 Mbps link from New York to the MCI location at Perryman (just outside Washington, D.C.) where a second PoP has been established.

MCI/Perryman is the location where DFN and CERN already terminate their transatlantic connections and is also the location of nodes of ESnet, the NASA network and vBNS. In addition to connections to the commercial Internet in the US, this configuration will allow DANTE to provide direct connections to the US research networks. Interconnection agreements have already been established with ESnet and NASA; a proposal to interconnect to vBNS was included in DANTE's response to the recent NSF Solicitation for intercontinental links from the US.

DANTE will initially provide services to the national networks in the Czech Republic, Greece, Hungary and Italy. Discussions are also being held with other national networks concerning the use of DANTE PoPs in combination with transatlantic links that they procure themselves. This will allow optimisation of traffic flows to the various network services in the US. The DANTE US service is expected to start at the end of October.